

AMATEUR WORK

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A ROWING SKIFF.

CARL H. CLARK.

The skiff here described is one suitable either for a tender to a yacht, or for pleasure rowing on rivers, lakes, or ocean. This type of boat is very desirable for use in shallow water, as it is of light draft, while the round up of the bottom forward makes landing on a shelving beach very easy. At the same time the boat is very staunch, safe and easy rowing. While not as handsome as a round bottomed boat, it is less expensive, and can be built by any amateur very easily.

The general scheme of construction is quite similar to that of the power dory previously described. The actual work will, however, be much lighter as the stock is not so heavy nor so long. The boat is 14' long on top, 12' long on the bottom, 4' 4" wide on top and 18" deep. It will carry four people comfortably and still be perfectly safe and easy to row. The bottom is built of pine with oak or other hard wood for frames, stem and sternboard. The bottom is $\frac{3}{4}$ " thick, and is laid out from the dimensions to the dotted line in Fig. 2. The lengths for this purpose are given in Fig. 1. It is left about 1 $\frac{1}{2}$ " wide at the forward end. On account of its width it will require to be made in three pieces; one piece in the middle with a narrow piece on each side being the best arrangement. The joints are planed smooth and even with a slight concavity, so that when forced together the ends will surely be tight, or the edges may be tongued and grooved if carefully done. They are laid on a flat surface and forced together with wedges and fastened on the upper side with cleats 3" wide and $\frac{3}{4}$ " thick. These cleats should be placed midway between the moulds, which are in the positions shown,

and are fastened with strong brass or galvanized iron screws. The bottom should then be beveled off on its under edge, as near as possible to the proper bevel, as it is much easier to do now than when the boat is set up. The centre line and the cross lines should be left on, as they are to be used in setting up the boat.

The stem is a crooked knee about 1 $\frac{1}{2}$ " thick, cut away to the dimensions shown. As will be seen, the outer piece of the stem is bent in place later, as in the power dory. It is beveled off to about $\frac{1}{2}$ " wide on the forward edge to give a flat bearing for the plank and is fastened to the forward end of the bottom with rivets. The sternboard is of $\frac{3}{4}$ " oak, shaped to the dimensions shown; these dimensions are of the after face, and wood for a considerable bevel should be allowed for to be trimmed up exactly when the plank is put on.

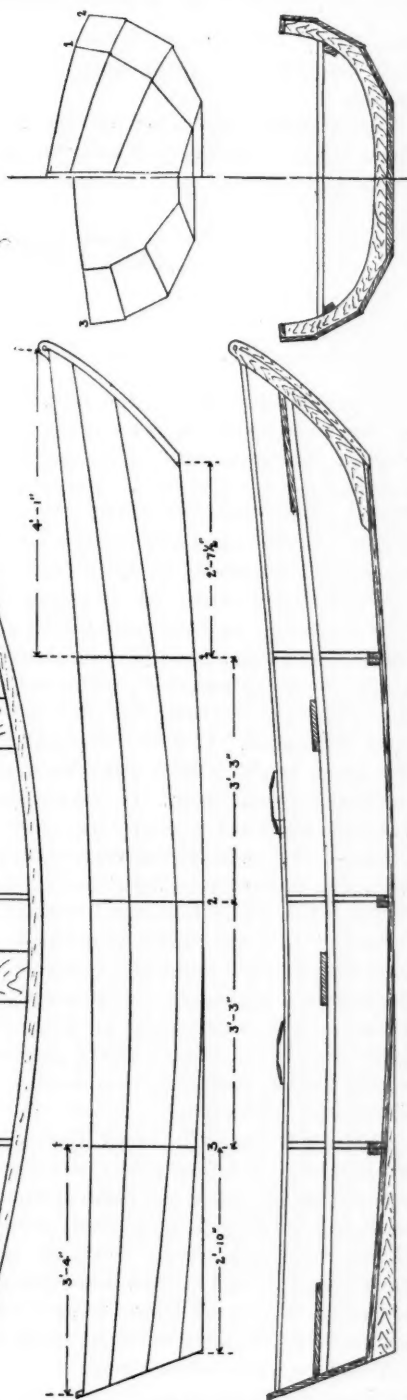
A light knee, shaped as illustrated, is fastened in the corner between the bottom and the sternboard; it holds the latter in place at the proper angle while the plank is being put on. A row of galvanized nails is also driven through the after end of the bottom into the sternboard. The frames or knees are of natural crook, two alike being made for each form shown. They are $\frac{3}{4}$ " thick, 3" wide, and are fastened together in pairs. The centerline should be marked across the foot of the pair and a brace should also be fastened across the top to keep them at the correct width.

The bottom is now supported at its ends on two blocks or horses at about the right height for working, the middle is then forced down 3 $\frac{1}{4}$ " by shores from the beams above and held in place.

The top plank is fitted in the same manner and is carried $\frac{3}{4}$ " above the tops of the moulds. The lower edges of the two upper planks are rounded off, and at the ends are smoothed off even with the surfaces of the stem and sternboard. A false piece for the face of the stem is cut out of the proper width to cover the ends of the plank, and rounded off on the forward edge. It is fastened on with screws.

Around the inside of the top strake and on the tops of the frames, gunwales $\frac{3}{4}$ " thick and 3" wide are to be worked; they are tapered at the ends to 2" wide. They are fastened to the tops of the frames and to the top strake; at the stern they are fitted neatly against the sternboard and a small knee riveted in. At the bow they are fitted to the inside of the stem and a V shaped knee or breast hook is worked between them and fastened with rivets.

The top of the stem is rounded off as shown, and a $\frac{1}{2}$ " hole bored for the painter. The top of the sternboard also is neatly curved and the edges rounded. The skeg is of $\frac{3}{4}$ " oak, 4" deep at the after end, tapering off to about $\frac{1}{4}$ "; it fits the after curve of the bottom and is fastened by nails driven through from the inside. The skeg, while not always necessary, makes the boat row more steadily. The strips which supports the seats are $2\frac{1}{2}$ " x $\frac{3}{4}$ " bent around inside the frames 6" down from and parallel with the gunwale. At the ends they are fastened to cleats. The upper edge is beveled off to allow the seats to lie flat. The seats are located as shown, and rest upon the strips just mentioned; the after seat is about 15" wide. When located in this way she will trim with either one, two, three or four passengers. The rowlocks are to be set into blocks on the gunwale as shown, 8" long,



2½" wide and 1 thick. Their correct position can be best found by experiment, after which they are fastened to the gunwale with brass screws.

The proper length for oars is about 8 ft. These can be bought very cheaply and are much

better than can be made by the amateur. The bottom may be left clear or fitted with gratings between the frames. They are made of narrow strips ½" thick, nailed on to the cross pieces. They should come about to the level of the top of the frames, and are easily removed for cleaning.

LANTERN SLIDE MAKING.

R. G. HARRIS.

IV. Toning with Gold, Copper and Uranium — Reducing and Intensifying.

In preparing to discuss the subject of toning lantern slides made on ordinary gelatine lantern plates, I must confess to having a rather decided bias against the operation. My opinion is that the finest slides are those in which the exact color is obtained by development, and I believe experienced workers incline to the same opinion.

When toning lantern slides there is always some danger of the gelatine becoming stained by the toning agent; in which case the high lights, which should be absolutely transparent gelatine, have their original purity degraded by the ground color of the slide. This fault is especially noticeable when toning slides with the uranium and ferricyanide toning bath. Unless very great care has been exercised a brown tint pervades the whole of the slide where clear gelatine should exist, due to the toning agent having stained the gelatine at the same time that it toned the image.

Many, if not all, toning processes have, at the same time, a slight intensifying action, and this intensification makes itself unpleasantly apparent when the slide dries, as the shadows usually become very heavy, losing the transparency one usually finds in slides that have not been subjected to toning operations.

Slides will either be toned from a black to a warm color or vice versa, and the most satisfactory results in toning are those obtained when a warm colored image is toned down towards black. If black images are toned to a very warm color the decided change is often accompanied by loss of quality, due to the length of time occupied in toning, or to the strength of solutions employed.

To tone a warm colored image to darker colors, platinum, gold sulphocyanide, and palladium may

be employed; while to tone a black image redder, one has to employ either copper or uranium ferricyanide, unless the image is converted into some haloid and again developed. Of these various toning agents the platinum bath for dark colors and the ferricyanide for warm colors are the most satisfactory.

A sulphocyanide toning bath, similar to that used for prints, may be employed to tone a warm colored image, but the color of the slide, if toned too far, becomes purplish black, and it is questionable whether such a color looks well in lantern slides. "Photographic purples" as they have been described, are best confined to silver prints, as the instances in which they suit the subject rarely occur in lantern slide work. The following formula may be used when a sulphocyanide toning bath is wanted.

Ammonium Sulpho-cyanide, 60 grains.

Gold tri-chloride, 5 grains.

Water, 16 ounces.

The gold should be dissolved in half the amount of water given, and the sulphocyanide in the remaining half, the solution of gold being added slowly to the sulphocyanide solution, stirring this all the time. Some form of platinum behaves even better. It should be noted that potassium chloro-platinite is the particular salt recommended, and not platinum bichloride. This latter salt is often quite acid with hydrochloric acid, and requires neutralizing first with some alkali and then reacidifying with nitric acid. If potassium chloro-platinite is used, no trouble will be experienced.

I have found that the formula usually given for platinum toning baths are too weak, requiring

an inconveniently long time before any marked change is effected. The following bath is much more concentrated than usually recommended, but gives very good results in my hands:

Potassium Chloro-platinite, 5 grains.
Gold tri-chloride, 5 grains.
Hydrochloric Acid, 10 minims.
Water, 5 ounces.

Platinum toning, if carried very far, intensifies the image slightly, so that should an attempt be made to tone a red colored slide quite black the slide might be found worthless on drying from the adventitious opacity acquired in toning. The most suitable slide for toning is one devoid of any great shadow masses, and one which wants just a little additional density to make it a perfect slide. The following modification of the gold-platinum bath is very convenient, as with it the increase of density is scarcely noticeable:

Sodium Phosphate, 50 grains.
Gold tri-chloride, 5 grains.
Potassium Chloro-Platinite, 5 grain.
Water, 5 ounces.

The bath must be used fresh, and will not keep. Toning with it is very rapid, but a pure black color is not readily procurable. Toning slides from black to warm is less easy than the foregoing, besides the alteration of color. Copper toning appears to give better results than uranium, as the staining of the gelatine previously referred to when speaking of uranium toning does not take place. Mr. Ferguson, who has done a large amount of experimental work in copper toning, recommends ten per solutions of copper sulphate, potassium ferricyanide, and neutral potassium citrate. To prepare toning bath we take:

Cupric Sulphate (10 per cent solution), 140 minims.
Potassium Ferricyanide (10 per cent solution) 120 m.
Potassium Citrate (neutral) 10 per cent ") 4 ounces.

The potassium citrate is added to the copper sulphate, and then the potassium ferricyanide is poured in, when a clear green solution results, which keeps well and tones readily, without staining, from purple black to red. Uranium is less satisfactory than copper owing to its liability to stain. As, however, beautiful results can be obtained with careful working, by the process. I do not feel justified in excluding it from notice. The exact strength does not seem of much importance, a stronger solution merely working

quicker. The following is a convenient strength.

Potassium Ferricyanide, 5 grains.
Uranium Nitrate, 5 grains.
Acetic Acid (glacial) 1 ½ drams.
Water, 2 ounces.

After toning, the slide is washed in running water for about ten minutes. Care has to be taken not to wash too long, otherwise the brown color is washed out, leaving the image in a very unsatisfactory condition. Uranium toned slides should be varnished when dry to prevent fading.

A very pleasant bluish green color may be given to a lantern slide that has been toned with the uranium toning bath if it is well washed and immersed in the following:

Hydrochloric Acid, 20 grains.
Iron Perchloride solution, 10 minims.
Water, 5 ounces.

The color obtained is very suitable for foliage subjects, but as the gelatine is stained throughout the slide any subjects with masses of high lights do not look well. The green color, however, can be discharged from any portion of the slide by treating it with a weak solution (say twenty per cent) of ammonia. Thus, the sky portion, where the stain shows more objectionably, can be cleared. Again, a slide, having been toned brown with uranium, can have certain portions of it toned green by applying with a camel hair brush the iron solution given previously; in this way a slide with two colors results, and some subjects look very effective when done in this manner.

In spite of the variety of results that can be obtained by toning methods, I would urge upon the lantern slide worker to devote all his care to gaining a high class slide by the unsophisticated process of development. Reducing and intensifying methods are of greater importance than toning formula. However expert and careful one may be, a certain proportion of his work will always be the better for re-adjustment in one direction or the other. Either some portion of the slide is over-dense and requires reduction locally, or the whole slide would be better for just a trifle more opacity. Lantern slides, unlike negatives, require their opacity to be exact, or the effect when they are projected upon the screen is unsatisfactory.

The reducer introduced by Mr. H. Farmer is particularly useful in slide work if not used too strong. One and a half grains to the ounce is

quite strong enough, though for local reductions of dense portions this may be slightly exceeded. The most convenient way of making up this reducer is to keep a ten per cent solution of the potassium ferricyanide made up, and to add ten or twenty minims of this to each ounce of water. The amount of hyposulphite left in the film and upon the surface of the plate when it is removed from the fixing bath is quite sufficient to effect reduction, though after reduction and a good rinse the plate may be replaced in the fixing bath for some minutes with advantage.

A good lantern plate with suitable developer should, on being removed from the fixing bath, show perfect freedom from any surface marks or deposit, except that which forms the image. Occasionally when developing for warm colors, an irregular white deposit occurs on the film. This may be removed by washing and rubbing slightly with a tuft of cotton wool, but the ferricyanide reducer is much simpler and safer. A weak solution is flowed over the plate two or three times, just long enough to remove the deposit without reducing the image. A reliable intensifier is especially useful when making slides having warm colors, as these slides are not easy to obtain of the exact density. The following formula may be relied upon to give perfectly satisfactory results without the least influence upon the color.

- A. Hydrokinone, 20 grains.
Citric Acid, 20 grains.
Distilled water, 20 ounces.
- B. Silver nitrate, 20 grains.
Nitric Acid, 5 minims.
Distilled water, 20 ounces.

Equal parts are taken to form the intensifier. The plate should be well washed after fixing and placed for some minutes in an alum bath, and again well washed before intensification. As the intensified slide, when dry, is somewhat denser than it appears when wet, allowance must be made for this and intensification stopped somewhat short of the required degree. The plate is rinsed thoroughly under the tap after intensifying and placed in the fixing bath for a short time to remove any silver chloride that may have been precipitated in the film. Another intensifier of considerable value to the lantern slide maker is that of M. M. Lumiere. The formula is:

- Sodium Sulphite, 1 ½ ounces.
- Mercuric Iodide, 20 grains.
- Water, 6 ounces.

The slide on leaving the fixing bath is well rinsed and flowed over with the above intensifier when density soon accrues. After a good washing, the slide is redeveloped with some developer such as amidol, etc.

Photography.

A LANTERN SLIDE HOLDER.

E. E. MESSENGER.

The lantern slide holder here described presents several advantages over any other which I have ever seen. It is compact, easily worked, and all slide are, when in position, in exact focus, which is not the case with holders having parallel ways, as with the latter either one or both slides must be slightly out of focus. With this holder the slide is carried in the front groove to the opening, then carried back into the back groove, where it remains during exposure, then withdrawn by the back groove.

The material required to make it consist of the wood from two large cigar boxes (250 size),

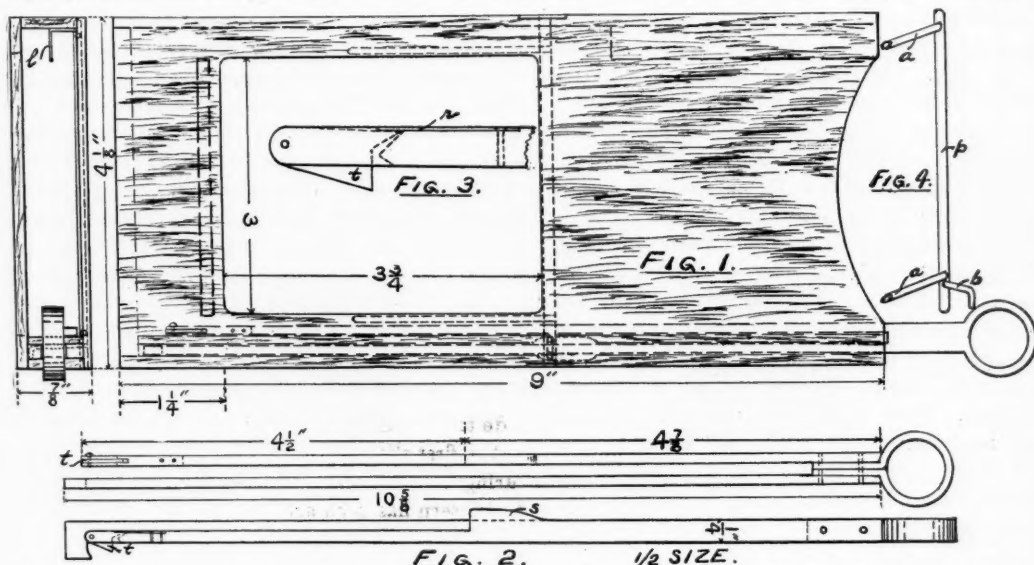
some strip brass about $\frac{3}{32}$ " thick and $\frac{1}{4}$ " wide, a piece of $\frac{1}{8}$ " round brass wire 4" long and three pieces of $\frac{1}{16}$ " steel wire $2\frac{1}{2}$ " long; also brass screws and small wire nails. Side and end views of the frame are shown in Fig. 1. Two sides are cut to the shape and dimensions shown, with openings where the slide is opposite the condensers. The opening in the side nearest the objective is $\frac{1}{8}$ " larger on the vertical dimension than the side nearest the condenser, $\frac{1}{16}$ " more at both top and bottom being cut out to allow for the arms *a* of the transferring device shown in Fig. 4. The right inner edge of the opening on the side near-

est the objective is also thinned with a gouge or file to allow for the rod *p*, Fig. 4.

The top piece of the frame is a strip of wood 9" long, $\frac{5}{8}$ " wide and $\frac{1}{4}$ ", or a little over, thick. To the inner right end of this is riveted an L shaped piece of brass b $3\frac{1}{2}$ " long, made by bending a piece of thin strip brass $\frac{5}{8}$ " wide. This is

between the outer edges of these two bottom pieces, the one on the objective side extending the whole length of the frame, and the one on the condensers side only $3\frac{1}{2}$ " from the right end. This last piece is not put in until the final putting together.

The carrier, as shown in Fig. 2, is next to be



shown at the top of the end view, Fig. 1. A piece of 2-point brass printer's rule, can be used, and can be obtained at any printer's office. At the same time get a piece of 8-point brass rule 12" long, from which to make the carrier to be described later. Two small pieces of brass $\frac{1}{8}$ " thick are also needed for bearings for the rod *p*, Fig. 4, and are $\frac{3}{8}$ " long, $\frac{1}{2}$ " wide. Holes centering $\frac{1}{8}$ " from the end, and $\frac{1}{16}$ " diameter are drilled in these pieces, also holes in each corner for small brass nails, and when the frame is put together they are nailed to the top and bottom pieces in slots cut to receive them, so that the centre of the large hole will be exactly $3\frac{1}{8}$ " from the right end.

Two strips of wood of same dimensions as the top piece are required for the bottom, which is double, the inner one being set $\frac{1}{8}$ " away from the other to allow the lower arm of the carrier to slide easily between them. Holes are bored $3\frac{1}{8}$ " from the right end and near the front edge for rod *p*, and a space cut out as shown in Fig. 1, around these holes to allow space for the arm *b*, Fig. 4. Two strips of wood $\frac{1}{8}$ " x $\frac{3}{8}$ " are glued

made; three pieces of brass $\frac{1}{4}$ " wide, $\frac{1}{8}$ " thick, one $9\frac{3}{8}$ " long, another $9\frac{3}{8}$ " long, and one $4\frac{3}{8}$ " long are needed. The short piece is bent to a $\frac{7}{8}$ " circle with two arms $\frac{3}{4}$ " long, to form the pull. If hard brass is used, it must be annealed by putting in a fire, heating to a red heat and slowly cooled. The upper arm made from the piece $9\frac{3}{8}$ " long, has the left end cut down to a width of a little over $\frac{1}{8}$ " wide for a length of $4\frac{1}{2}$ " on the inner end. A boss, s $\frac{1}{8}$ " wide and $\frac{3}{4}$ " long is brazed on to the front edge as shown in the top view, Fig. 2. A slot is then cut with a hack saw in the end as shown in the side view, Fig. 2 for the tongue *t*, and enlarged view of which is shown in Fig. 3. This slot is cut $\frac{5}{8}$ " deep from both sides to leave a V shaped projection.

A spring *r* about 1" long, and $\frac{1}{8}$ " wide made of thin spring steel, to be obtained of any jeweller, is then riveted in a recess filed in the front edge of the arm so that the end will press on the edge of the tongue *t*, causing it to project as shown in Fig. 3. The tongue is filed up from a piece of thin brass, to the shape shown in Fig. 3, holes

drilled and a riveted bearing made at the outer end.

The lower arm has at the end a hook shaped projection which is brazed on, as shown in the top view, Fig. 2. When the arms are completed they and the pull are brazed and riveted together. The transferring device, shown in Fig. 4, is next to be made. In a piece of round brass rod $\frac{1}{8}$ " diameter and $4\frac{1}{2}$ " long, drill two $\frac{1}{16}$ " holes in line, one $\frac{1}{2}$ " from the top end, the other $\frac{3}{8}$ " from the bottom side. Drill another hole $\frac{5}{16}$ " from the bottom end at right angles to the other two holes. The two arms *a*, Fig. 4, are made of steel wire $2\frac{5}{8}$ " long, and full $\frac{1}{8}$ " diameter. The arm *b* is $\frac{3}{4}$ " long, with a little over $\frac{1}{8}$ " on the end turned down as shown in Fig. 4.

After making an end piece of wood $3\frac{1}{8}$ " long, $\frac{5}{8}$ " wide and $\frac{3}{16}$ " thick, the frame can be put together. It can be nailed with small brass nails, but wood screws are preferable, allowing repairs to be made more easily, but the heads must be countersunk, and holes drilled to avoid splitting the wood. First fasten the top end and side pieces together, following with the inner bottom piece, after putting in position the transferring device. Then put in the carrier, the two wooden strip on either side of the lower arm of carrier

and then the outer bottom piece. Put in only a few screws at first and try the carrier to see that it does not bind anywhere. A piece of wood $\frac{1}{2}$ " long to serve as a stop, is then put between the two sides $\frac{1}{8}$ " to the left of the opening. One or two coats of shellac varnish will give a good finish to the wood and the brass can be laquered if desired.

To operate, pull out the carrier, put a slide in the space in front of the upper arm, then push on the carrier; the boss, *s* pushes the slide in till it meets the wooden stop. Then pull out the carrier again; at nearly the end of this movement the catch at the end of the under arm engages with the arm *b*, causing the arms *a*, to press against the front of the slide, moving it to the space at the back of the opening. Another slide is then put in, moved forward as before, in front of the one now there; the tongue *t* is pressed back as it passes the slide first put in until beyond it, when it again projects, and upon pulling out the carrier brings out the first slide, allowing the second slide to be transferred to the space just vacated by the first slide. It will be noted that each slide, during exposure, is in the one space for which the lantern has been accurately focused.

PATTERN MAKING FOR AMATEURS.

F. W. PUTNAM.

III. Green Sand Cores—Two Simple Patterns.

It often becomes necessary for the pattern maker to make a pattern for a casting that is to be hollow, or to have a hole through it, in which case it is customary to make the pattern of such form that it will leave a body of sand in the mold about which the metal will flow. The body of sand left in the mold forms the desired hole or opening, as shown at *a*, Fig. 9. This body of sand projecting up into the mold to form the opening in the casting is called a *core*, and may be left by the pattern itself, as in Fig. 9, or it may be made in a separate device, called a *core box*, and placed in the mold after the pattern has been drawn out. Cores made by the pattern alone are called *green sand core*.

Fig. 9 represents a mold made by a pattern of the shape shown in Fig. 10, which shows the casting of shoe. The pattern for this shoe will be the same shape as the casting, the necessary allowance being made in the size of the pattern to cover the shrinkage and finish of the casting.

SHOE.

For this pattern use a piece of clean dry pine. Plane the block to the required width and thickness and square the ends to the desired length. The first side planed up should be carefully tested with a try square; when found to be perfectly straight and true, it should be marked with two short parallel lines. This side is called the *face side*, and we will generally, in this pattern work,

consider the top surface of the pattern, as it is drawn from the mold, to be the face side. The next side is planed up it at right angles to the face side and is called the *joint side*. This side is tested with the try square, and when found to be straight and exactly at right angles to the face side is marked with one short mark. The block is gauged for thickness from the face side, and the third side is then planed down to the gauge line and is tested from the joint side.

point on the scale originally coming directly in line with the spur. The marks which are to be made on the face and joint sides of the block are called *witness marks* and are shown in Fig. 10.

Having finished the block to the required size, mark out the rectangular hole which is to be cut through the block as indicated by the dotted lines in the right end view of Fig. 10. The lines should be marked on both the top and bottom faces of the block, making sure that both the top

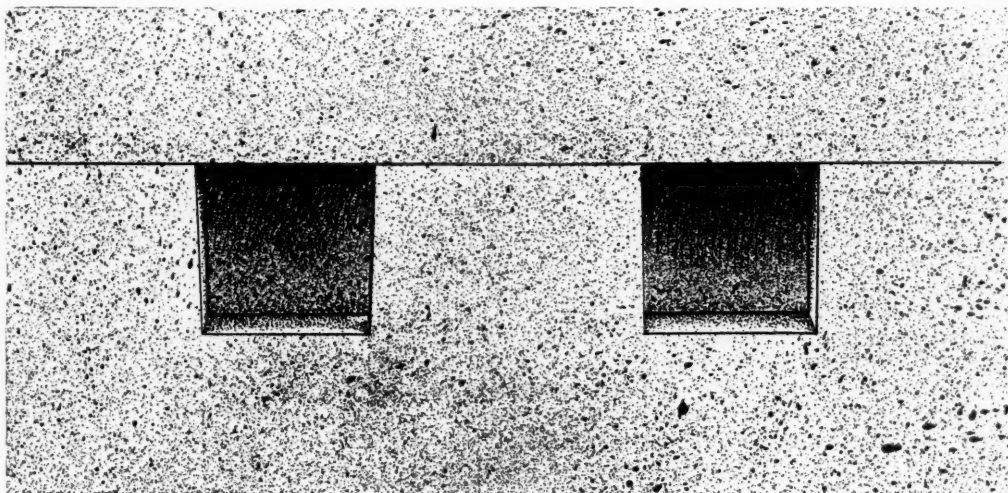


FIG. 9. MOLD MADE BY PATTERN.

The block is gauged for width from the joint side, and the fourth side is planed down to this gauge line, being tested from the third side. Gauging should always be done from the face and

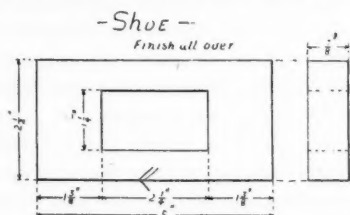


FIG. 10. PATTERN FOR SHOE.

joint sides of the block. In setting the gauge always measure the distance from the spur to the head with a rule, as the spur may easily have been bent and so make the scale which is cut on the bar of the gauge of no practical value, the zero

rectangles are correctly located and of the right dimensions. Holding the block in a vise, next bore four holes with a $\frac{1}{4}$ " auger bit, one in each corner of the rectangle, the edge of the hole coming $\frac{1}{8}$ " inside the rectangle. In boring holes advance the bit until the spur just pierces the opposite surface, then remove the bit, turn the block round in vice and bore back. In this way there should be no splintered surfaces as a result of boring. A $\frac{5}{8}$ " auger bit should next be used, six holes being bored, one next each short side, and two next each long side, $\frac{1}{8}$ " being left in each case from the edge of the bit holes to the border lines of the rectangle.

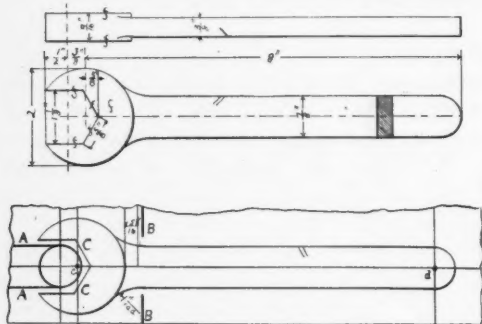
The hole is to be finished with a chisel, following the directions given in the last article. This hole should first be squared up from the face side, with no allowance for draft. Remembering that the face side is to be the top side of the pattern,

the allowance for draft is next made. The sides of the hole may be tapered with a flat wood rasp, in which case a file with one narrow edge "dead smooth" should be used. Such a file is generally known as a safety edge file. The safety edge is brought against the corners of the hole and prevents the file from digging in and so spoiling the shape of the hole. The sides of this hole should be carefully tested for draft, being very sure that there is no back draft. The draft allowance on the outside surfaces is finished last.

In clamping the pattern in the vise for chiseling, it will be found advisable to clamp a block against the pattern, thus preventing the wood from being broken away on the back surface of the pattern. A very little practice of this sort in the use of chisels, will be sufficient to warn the amateur that his chisels must be kept sharp, with a perfectly straight bevel not too blunt, and a straight edge.

OPEN END WRENCH.

The third pattern is a common form of open end wrench and is shown in Fig. 11. The block for this pattern should be about $9\frac{1}{2}$ " long, $2\frac{1}{2}$ " wide and $\frac{3}{8}$ " thick. The face side, joint side and third side should be planed up and tested. Set the gauge at $1\frac{1}{8}$ " and mark a centre line on both the wide surfaces, gauging from the joint side the whole length of the block. On this centre line



FIGS. 11 and 12. OPEN END WRENCH.

measure off a point $1\frac{1}{8}$ " from one end of the block. This point will be the centre *c*, Fig. 12, for the circle outlining the head. With the try square and knife mark a line through this point across the face side, next duplicating the line on the opposite side, squaring from the joint side. Measure off and make a line on the opposite end

$7\frac{9}{16}$ " from the first cross line drawn. This second point *d*, Fig. 12, will be the centre for the half circle outlining the handle. Set the compasses at 1" radius and scribe a circle with *c*, Fig. 12, as centre. Mark this circle on both sides of the block. Next set the compasses at $\frac{7}{16}$ " radius and with *d* as centre, scribe a half circle on both sides of the other end. The remainder of the outline of the wrench is next to be drawn, following the dimensions given in the figure.

Having drawn the outline on both sides of the block, bore a hole with $\frac{3}{8}$ " auger bit as in Fig. 12. With a hack saw make cuts at *a*, Fig. 12, to meet the hole just bored. With a suitable chisel finish this opening down to the line, as there is now less chance of splitting this end of the block, beginning at *c*, Fig. 12 for the same reason. When this is done, make two saw cuts at *b*, Fig. 12, and rough down the block with a chisel. In finishing the curved fillet near *b*, begin with a medium sized gouge and finish with a half round wood file.

After completing the outline, gauge two lines on the edge of the handle, each $\frac{3}{32}$ " from the broad surfaces, to designate the thickness of the handle. With the paring chisel remove the portion outside the lines, cutting true to the lines and straightening across, leaving $\frac{1}{8}$ " next to the outline of the head, to afterward form a fillet where the head and handle join. This fillet may be formed with a very small gouge or a round "rat tail" file. Remembering that the face side is to be the top side of the pattern when removed from the mold, give the necessary draft to the pattern, not forgetting the opening at the head end of the wrench. Sandpaper the handle lengthwise, placing the sandpaper on a block for all flat surfaces. Round the corners very slightly with sandpaper and the pattern is ready for finishing.

FINISHING PATTERN.

All wooden patterns should be covered with some protective coating so as to prevent warping, due to the moist sand in the mold and to prevent glued joints from coming apart. This coating will give a smooth and glossy finish to the pattern, thus facilitating its withdrawal from the sand. Finished patterns, too, escape much of the rough usage commonly given them by moulders.

In practice there are two general classes of pattern varnishes. The first is composed of

Shellac, with or without some coloring ingredient. The second comprises the better grades of *copal* varnishes. Copal varnish gives a better lustre than shellac but it is very slow in drying as well as more expensive, and so will not be thought of in connection with the finishing of our patterns. By changing the color of the shellac varnish, we may distinguish between core paints and the main body of the pattern, and also between patterns for different purposes, as, for instance, pattern for brass, iron, steel castings, etc.

Orange shellac varnish is made by dissolving orange shellac in alcohol. The orange shellac comes in thin flakes and may be dissolved either in wood (methyl) alcohol, or in grain (ethyl) alcohol. Wood alcohol is always *poisonous*, if taken into the system and shellac mixed with wood alcohol is very liable to turn to a muddy color, therefore, I strongly recommend the use of grain alcohol. Black shellac varnish is made by add-

ing dry ivory black, or lamp black, to the orange shellac. We will use for our work black shellac for the main body of the patterns and the outside of the core boxes, and orange shellac for core prints and inside of core boxes.

First wipe the pattern clean and free from dust. The first coat of varnish should be fairly thick, applied smoothly, and allowed to soak thoroughly into the pattern. When this coat has become thoroughly dry, the pattern will feel rough, because the varnish has hardened any little projecting particles of the wood. This first coat should be rubbed smooth with a well worn piece of fine sandpaper, being careful not to cut through the varnish. Having wiped the pattern free from dust, apply a second coat of varnish, somewhat lighter than the first. This coat, when dry, is again rubbed down, and a third coat applied, three coats being usually enough to render the pattern impervious to moisture.

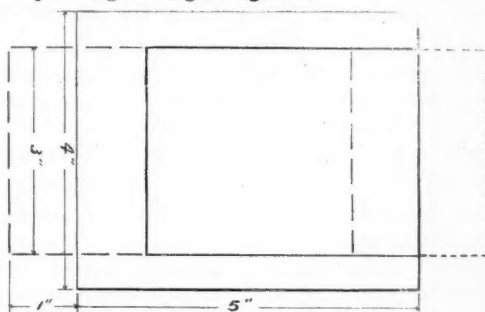
AN OIL IMMERSSED CONDENSER.

ARUHTR H. BELL.

The peculiar property of a condenser, of retaining charges of electricity is a valuable factor in spark coil operation. In the primary circuit of a coil, or more accurately speaking, across the make and break contacts of the primary circuit of a coil, we introduce a condenser which greatly increases the efficiency, by taking up the "extra" current induced in the primary. Often times these condensers are simple Leyden jars, and sometimes tin foil sheets insulated one from the other by waxed paper. In either case we have a conducting surface conferring, by induction, capacity upon another, and the more layers of foil and paper, or Leyden jars, as the case may be, the greater the capacity.

We find, in attempting to operate a make and break vibrator on an induction coil, where the condenser has been removed, that there is little or no spark at the secondary gap, and a very pronounced arc at the vibrator contacts. This arc tends to smut and eat away the platinum contact points, and we note that increasing the number of cells of battery causes a fatter arc at this point. We reason, therefore, that this spark

must be attributed to the extra current caused by magnetic influence of a soft wire core, and not to be any direct effect of the few cells used, for a separate test shows the cells to be incapable of rendering such a spark, without a core winding in the circuit. This spark value of a core enters into the construction of "wipe sparks" coils used in operating some gas engines.



If we introduce across the spark gap, a condenser constructed of a very few layers of foil and wax paper, we note that the spark or arc at the contacts diminishes, and the secondary spark lengthens. From this we reason that more capac-

ity, that is, a larger condenser will cut down the spark to a point where the arc no longer damages the platinum, and a maximum spark results in the secondary. Likewise, in increasing the battery strength we find it necessary to increase the condenser capacity, to control the sparking.

A condenser for a primary discharge seldom punctures under primary influences, even if constructed of quite thin wax paper, but such a construction would preclude its use across the terminals of a secondary. For many of us have seen by experience, that a secondary discharge of less than half an inch will pass through many substances like waxed paper, fibre, rubber, mica, etc., which are practically perfect dielectrics with low potential, and any ordinary condenser of wax paper and foil would puncture through and through with the first discharge of such a secondary.

We find, however, that a series of Leyden jars of a specified capacity will change the character of the secondary spark. While the length is diminished, the spark becomes a fat flame, and its color is changed to a dazzling white. As different capacities of condensers are required for various lengths of discharge, the importance of arranging a set of condensers adjustable to ones requirements becomes patent. Leyden jars are bulky, and easy to accidental discharge by contact with exterior substances, so we must resort to an adaption of an old-time idea, known as "Franklin plates." Almost every amateur or a friend has disabled more or less in dry plate photography, and glasses of 4" x 5" dimensions are readily obtained. The gelatine film can be removed by an application of hot water.

Next procure at a hardware store, 50 pieces of very thin tin (tinned iron) which is cut into pieces 3" x 5" square. Procure some pieces of card board of same thickness or a trifle thicker than the tin. Cut 50 pieces 4" x 5", and then remove from each piece a 3" x 4" section as illustrated in the diagram.

With shellac securely attach a piece of the board to each glass, and the insert a strip of tin in the space provided for it. In assembling this condenser, take twenty glasses and tins, and stack the one on the other so that the projecting ends of 1, 3, 5, 7, etc., will protrude at one end, and 2, 4, 6, 8, etc. at the opposite end. These

glass plates should then be firmly tied in place with binding twine. Next do another twenty in the same fashion; also the remaining two fives. Solder a heavy wire, which we will designate as a "lead," to the edges of the strips protruding at at each end, and have these leads long enough to permit connecting one condenser to another when desired.

When we connect these sections in series, the combined capacity is equal to the sum of capacities of each condenser, and when two condensers are connected in parallel, the combined capacity is equal to the product of the individual capacities, divided by the sum of these capacities. Also with three condensers in parallel we figure the combined capacity of any two, by this formula, and using this resultant capacity, continue the calculation with another condenser. By using different combinations in series and parallel, we are able to vary our capacity to quite an extent.

Immersing these condensers in a liquid tight container of wood, or a jar, filled with insulating oil, like transil, parafine or linseed oil, renders them more efficient under high potential conditions.

U. S. Consul-General Guenther, Frankfort, Germany, reports a newly invented "milk stone," or galalith, or petrified milk. It is manufactured from skim milk in the following manner:— By a chemical process the casein is precipitated as a yellowish brown powder, which is mixed with formaline. Thereby a hornlike product is formed called milk stone. This substance, with various admixtures, forms a substance for horn, turtle-shell, ivory, celluloid, marble, amber, and hard rubber. Handles for knives and forks, paper cutters, crayons, pipes, cigar holders, seals, marble, stone ornaments, and billiard balls are now made of skimmed milk. The insolubility of galalith, its easy working, elasticity, and proof against fire, make it very desirable. Already 20,000 quarts of skimmed milk are daily used for this purpose in Austria.

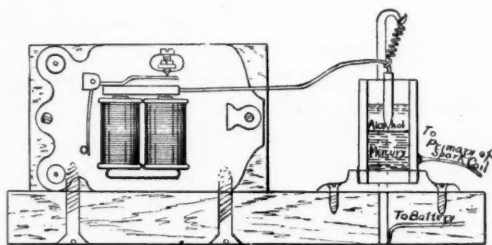
The Amateur turning lathe is a practical, well made tool. Those who have already received them are more than pleased with its construction.

A MERCURY INTERRUPTER.

GEORGE J. ATKINS.

Mercury interrupters have long been popular with users of high potential coils, but their cost, as compared with the simpler spring hammer vibrators, precluded their general adoption by amateurs.

Following is given a description of an efficient mercury-dip interrupter which was constructed from a cheap $2\frac{1}{2}$ " door bell. The bell was stripped of gong and cover, and the ball hammer that taps the gong, and then mounted edgewise on a piece of wood $3\frac{1}{2}$ " x $2\frac{1}{2}$ " attached by screws to the base board which is about 5" x 7". The rod carrying the hammer was left on the armature, in the fact the rod had to be lengthened by soldering on a short piece of brass wire.



The dash pot which contains the mercury, is a piece of iron gas pipe about $1\frac{1}{2}$ " long, and $\frac{5}{8}$ " diameter, and also fastened to the base board by fitting an iron cap to the lower end, or the bottom end may be plugged with a piece of wood. On the end of the brass wire soldered to the hammer rod, is fitted a cigar-shaped piece of brass rod of about $\frac{1}{8}$ " diameter. This shape was adopted to permit easy ingress and egress in the mercury. A half inch of alcohol is kept in the pot on top of the mercury when in use. One side of the primary battery, used to energize the primary of the coil, is connected to the iron dash pot, and the other side of the battery to the primary of the coil. The return end of the primary coil, is connected by means of a very flexible wire spring to the hammer rod of the bell, the spring being held by a brass rod, the lower end of which is driven into the base board and the upper end formed with a

hook. A spring can be made by winding fine brass wire around a wire nail. A separate cell or two of battery is used to operate the bell armature, and adjustment is made by bending the hammer rod or "make-and-break" rod, so that the brass contact will be just outside of the mercury, but still covered with alcohol when the bell magnets are not energized.

When the bell armature operates, the contact piece enters well into the mercury, thus completing a circuit for the coil battery.

U. S. Minister H. N. Allen, of Seoul, Korea, has issued the following circular letter as a reply to the many inquiries from the United States at that legation relative to ginseng seeds and plants, and how to secure the same, etc. It is becoming impracticable for his office to give attention to the numerous requests for information regarding ginseng received by every mail or to furnish supplies of ginseng seeds and plants.

Information may be had on the subject from the publications of the United States Department of Agriculture and from the numerous firms engaged in supplying ginseng seeds and roots in America. With great difficulty living roots have been shipped to America and a reliable supply must now be available. At least one enterprising American (of San Francisco) has spent some months at the ginseng farms in Korea, studying the culture and conditions and taking away with him a large shipment of living plants, so that dealers in the United States must now have a plentiful supply of reliable plants and fresh seeds.

Ginseng seeds are not supposed to germinate after having dried out. Even if there were seeds in Korea, therefore, it would be useless to secure ginseng seeds from them. The ginseng farms are some 60 miles distant from Seoul, and there is no person there to whom one may apply for seeds or plants. The American missionaries residing near the farms have wisely decided not to attempt to export the seeds and plants, as such a course would ultimately cause trouble for them with the natives. If all the ginseng plantations in America succeed the product will be of little value. The only market for the roots is in China and it is overstocked, while the Korean product which seems to be of especial value, due to conditions of soil and climate, is increasing so greatly that the purchasers of the last crop were obliged to destroy a large quantity in order to keep the supply within the demand

AMATEUR WORK

77 WILBY ST., BOSTON

DRAPER PUBLISHING CO., PUBLISHERS.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

Subscription Rates for the United States, Canada and Mexico \$1.00 per year. Single copies of any number in current volume, 10 cents.

TO ADVERTISERS.

New advertisements, or changes, intended for a particular issue, should reach the office on or before the 15th of the previous month.

Entered at the Post-office, Boston, as second-class mail matter Jan. 14, 1902.

MAY, 1904.

To make this magazine of the greatest possible value and interest to its readers, is the earnest desire of the publishers. In the selection of subjects to be presented in the successive issues the wants of readers are followed in every possible way in which these wants have been indicated. We think, however, there are many readers who have in mind some particular subject in which they are especially interested, and we earnestly request every reader to write a short letter advising us upon the following points.

1. What general subject is most of interest to you; that is, electricity, mechanics, wood working, boat building, photography, etc.

2. What additions or changes can you suggest, which would make the magazine of greater value and interest.

A general response to this request will enable us to carry out more satisfactorily certain plans now in preparation, and we earnestly request that each and every reader will favor us at an early date with their suggestions.

We have received numerous inquiries calling for special reply by mail, yet without the neces-

sary enclosure of stamp for return postage. These are now so numerous that we are obliged to decline to reply by mail to inquiries not accompanied with postage. We must also announce that replies to inquiries upon technical subjects are subject to delay; as considerable investigation is sometimes necessary before a reply can be sent.

BOOKS RECEIVED.

BENT IRON WORK, BASKET WORK, TAXIDERM.

Handicraft series, edited by Paul N. Hasluck, 160 pp. 4 x 7 inches, 50 cents each. Cassell & Co., Ltd. London and New York.

The Handicraft series of manuals, in which the above mentioned three books are included, present the several subjects upon which they treat in a plainly written and well illustrated manner. Nineteen different manuals are included in the series, a list of which may be obtained by application to the publishers. Many of them are upon subjects which are of undoubted interest to readers of this magazine, and are recommended as being of much value and interest.

WHO DISCOVERED PHOTOGRAPHY. George E.

Brown and C. W. Canfield, Photo-Miniature, 25 cents. Tennant & Ward, New York.

All photographers will find this number of much interest. The historic development of photography is traced from the beginning to the present day, and many parts have all the interest of romance, while being but the presentation of facts of the past. It could well be taken up as supplementary reading in manual training schools.

The Technical World is the name given to a new monthly magazine published by the American School of Correspondence, Chicago, Ill. As its name implies, it is of a technical character, but not to such an extent as to be without interest to the general reader. The various subjects presented in the first number include:—"Radium, The Milling Machine, Wireless Telegraphy, Exhaust Steam Heating," and miscellaneous subjects in similar lines. The large number of eminent writers available to the publishers will enable them to make the magazine of undoubted interest to those desirous of following the progress of scientific and industrial affairs.

A CHAMBER SET

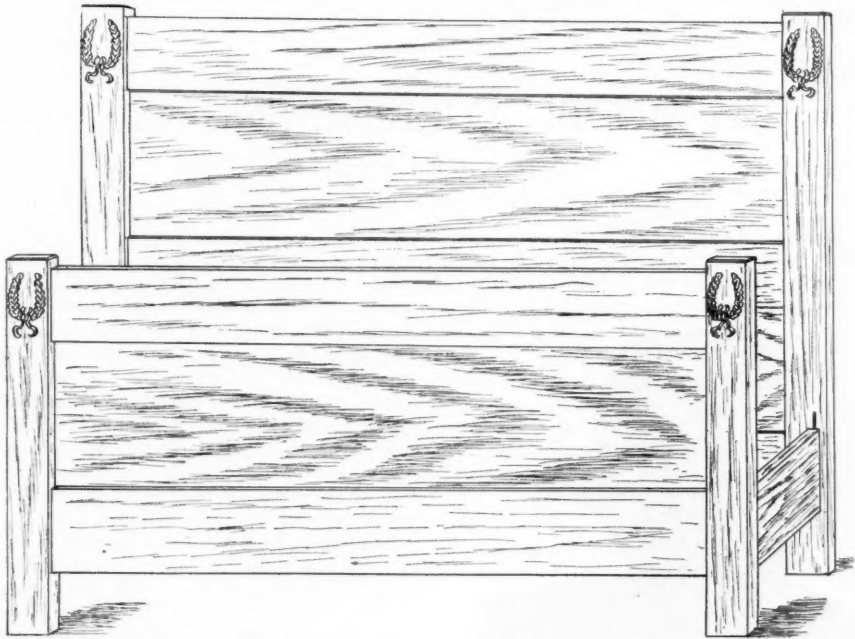
JOHN F. ADAMS.

I. The Bedstead.

The chamber set to be described in this and following numbers of this magazine is of colonial design, with a strong, substantial appearance, and yet not carried too far in the way of heaviness. It is such a set as any woodworker will find pleasure in the making, and pride in its possession when completed. It can be made in either mahogany or oak, though more especially adapted to oak; the strong marking of the latter wood when brought out with a dark finish producing an exceptionally fine appearance.

The three latter pieces may have to be glued up, but this should be avoided if possible to secure well marked stock of the full width. It will also be necessary to make sure that all the pieces are thoroughly dried, as shrinkage in the completed work will be quite objectionable.

To begin with the head-board; the corner posts are 4' 6" high. The upper cross piece, 7" wide, is 1" over than the top of the posts, mortises 1" deep being made for same the full size of the cross piece. Another mortise for the centre cross



The material required is as follows:

- 2 pieces 4' 6" x 4" x 1 $\frac{3}{4}$ "
- 2 pieces 3' x 4" x 1 $\frac{3}{4}$ "
- 2 pieces 4' x 7" x $\frac{3}{8}$ "
- 2 pieces 4' x 8" x $\frac{3}{8}$ "
- 1 piece 4' x 6" x $\frac{3}{8}$ "
- 2 pieces 6' x 8" x $\frac{3}{8}$ "
- 2 pieces 3' 11" x 14 $\frac{1}{2}$ " x $\frac{1}{4}$ "
- 1 piece 3' 11" x 12 $\frac{1}{2}$ " x $\frac{1}{4}$ "

piece, 6" wide, is made 14" below the upper one. The mortises for the lower cross piece, 8" wide, is 12" below the centre one, the lower edge being 6" from the floor. These mortises are all centered on the posts.

The upper panel is 14" wide in the clear; the lower one 12" wide. Grooves $\frac{5}{8}$ " deep are cut in the cross pieces and posts to receive the edges

of the panel pieces; and so located as to have the panels set in $\frac{3}{8}$ " from the front of the cross pieces. Accurate measurements must be made and lines laid off with a marking gauge. A $\frac{1}{4}$ " grooving plane will be necessary to cut the grooves in nice shape. On the front of the post a slot is cut for the side board hangers which centres 1" from the outer edge of the post. The hangers should be purchased in advance from which to ascertain the correct width of the slot, which should be located to bring the side board 6" from the floor, before castors are added. When all fittings are completed, the head board is set up with glued joints and further strengthened by two $\frac{1}{4}$ " dowel pins put through from the back so not to show at the front.

The foot board is made in the same way, the posts being 3' high; the upper cross piece 7" wide, the lower one 8" wide and the panel 14" wide in the clear. The top edge of the upper cross piece is 1" below top of the posts. The cross pieces are

also pinned with dowel pins put through from the back, and carefully cut off to show as little as possible. Slots for the side boards are cut on the inside at same height as on the head board.

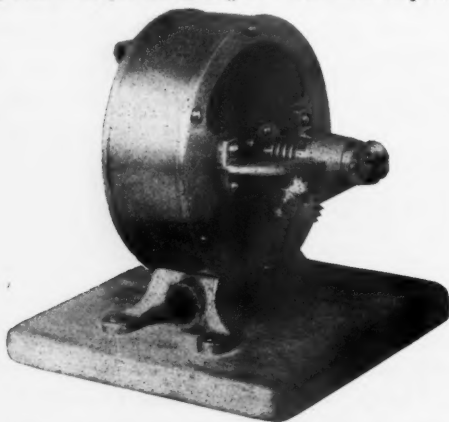
The side boards are 6' long and 8" wide. The method of providing for the slats can be seen by inspecting any wooden bed, so will not be described. After setting up both head and foot-board, the tops and bottoms of the posts on both are beveled off slightly as shown. The ornamental carved work shown at the tops of the posts can be purchased of furniture manufacturers supply houses located in most of the large cities, but can be omitted if not obtainable. If same are purchased, two others of slightly smaller size should be got at the same time for the bureau, if same is to be made, and which will be described in the next number. The finish may be a dark green or brown or black, if of oak, and dark mahogany if the latter wood is used.

A MODEL TURBINE ENGINE.

ARTHUR J. WEED.

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In designing and constructing a model turbine engine we are confronted with several problems which do not have to be taken into consideration when dealing with a reciprocating engine. The most important

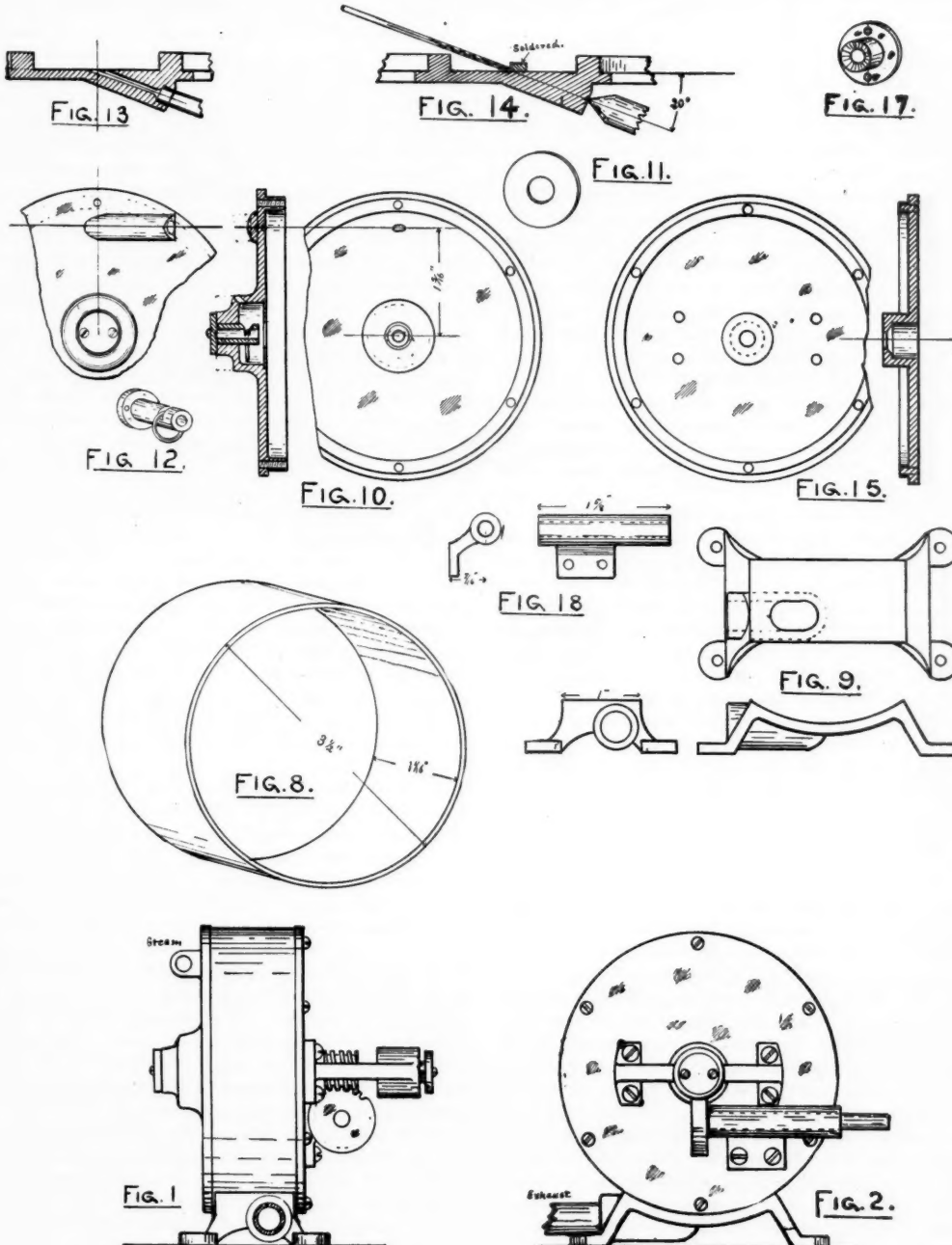


of these are:—The high speed; the balancing of motive parts, adequate bearings and a positive oil supply. In the design here given, these details have been carefully worked out, yet the construction is such that it will not be found difficult of accomplish-

ment by any amateur possessing a small lathe fitted with a plain slide rest.

In the turbine engine the principle that "Action and reaction are equal" is most practically demonstrated. The most efficient turbine engine is the one having a comparatively large number of buckets, but to secure this in a model the size of the one here shown, it would be necessary to turn out the motor wheel with a solid rim, like the flywheel of an engine, and mill out the buckets from the solid metal using an end milling cutter for the purpose. This construction would necessitate the use of special facilities with which few amateurs are equipped.

Before beginning a detailed description of the parts, we will first study the general arrangement of the assembled model. Fig. 1 and 2 show the complete model. From these views it will be seen that the steam inlet is cast as a boss on the side of the casing instead of being a separate piece, for which a hole would need to be drilled diagonally through the casing. The exhaust steam passes out at the bottom of the casing, which facilitates the keeping of the interior free from water. The reduction of speed is accomplished by a worm wheel mounted on the turbine shaft and engaging with a gear on the driving shaft. This permits of a reduction of twenty to one, yet allows an increase of speed, if so desired, by substitut-



ing a smaller gear on the driving shaft. The side thrust of the jet of steam on the turbine wheel is offset by the thrust of the worm wheel on the gear of the driving shaft.

The shaft of the turbine wheel is made as long as possible, and the outer end supported in an outboard bearing. Each bearing is fitted with an oil ring and reservoir. Where the shaft passes through the casing

a stuffing box and gland is introduced. As the pressure at this point is only that of the exhaust steam a piece of felt or candle wicking will be sufficient packing to use. We will first consider the construction of the turbine wheel.

This piece of the model requires to be very carefully constructed, and when completed the wheel should be in perfect balance. The design requires forty vanes or buckets arranged around the circumference of the wheel. Figs. 3 and 4 show in detail the construction of the wheel. This wheel is made with a solid web between the hub and rim, instead of being spoked; the reason for this being that the entire surface of the wheel may be turned up true to make it run in perfect balance. The shape of the buckets is shown in Fig. 7. The shape of the lower portion of the bucket is spherical with a projection which fits into a slot of the wheel. The forming of these buckets will be the greatest difficulty that the amateur will encounter in the construction of the model. These, however can be procured formed up and trimmed ready to set in the wheel.

To form up the buckets take two pieces of steel $\frac{3}{8}$ " x $1\frac{1}{2}$ " and about 2" in length. Clamp the two pieces together and drill two $\frac{1}{8}$ " holes for guide pins near one end, as shown in A, Fig. 19. The opposite ends must be squared up and a center punch mark made on one of the pieces 5-64" from the edge where the two pieces join. Drill a small hole to a depth of $\frac{3}{8}$ ", using a drill about No. 24 size. With the two pieces firmly clamped together drill into the same hole with a $\frac{1}{8}$ " drill to the same depth and follow this up with a ball end cutting mill as shown in B, Fig. 19. This can be made from a piece of $\frac{1}{4}$ " steel and the end rounded to a spherical form. The teeth can be filed in and the tool then hardened and tempered. When using this tool it will be necessary to remove it from the work often and clear the teeth of the particles of material cut away from the work. If this is not done the grooves will fill up and the cutter refuse to work. When the depression is cut to the proper depth a piece of $\frac{1}{8}$ " steel is turned to the same form as the end of the cutter and inserted in one of the pieces of steel as shown in D Fig. 19. This can be fastened in position by a rivet. This forms a punch and die for forming up the buckets. The material of which the buckets are made should be soft brass about No. 26 gauge. This should be cut into pieces considerably larger than the size of the buckets, say one inch square. Place the forming tools with the "die" below and lay one of the pieces of soft brass in position on it. Place the "punch" above it on the guide pins, and holding the three pieces together, transfer them to a large vise and squeeze them together firmly. On relieving the pressure the sheet of brass will be found in the form shown in E, Fig. 19, and only requires to have the flat part trimmed away to make it into a bucket of the proper shape for this model.

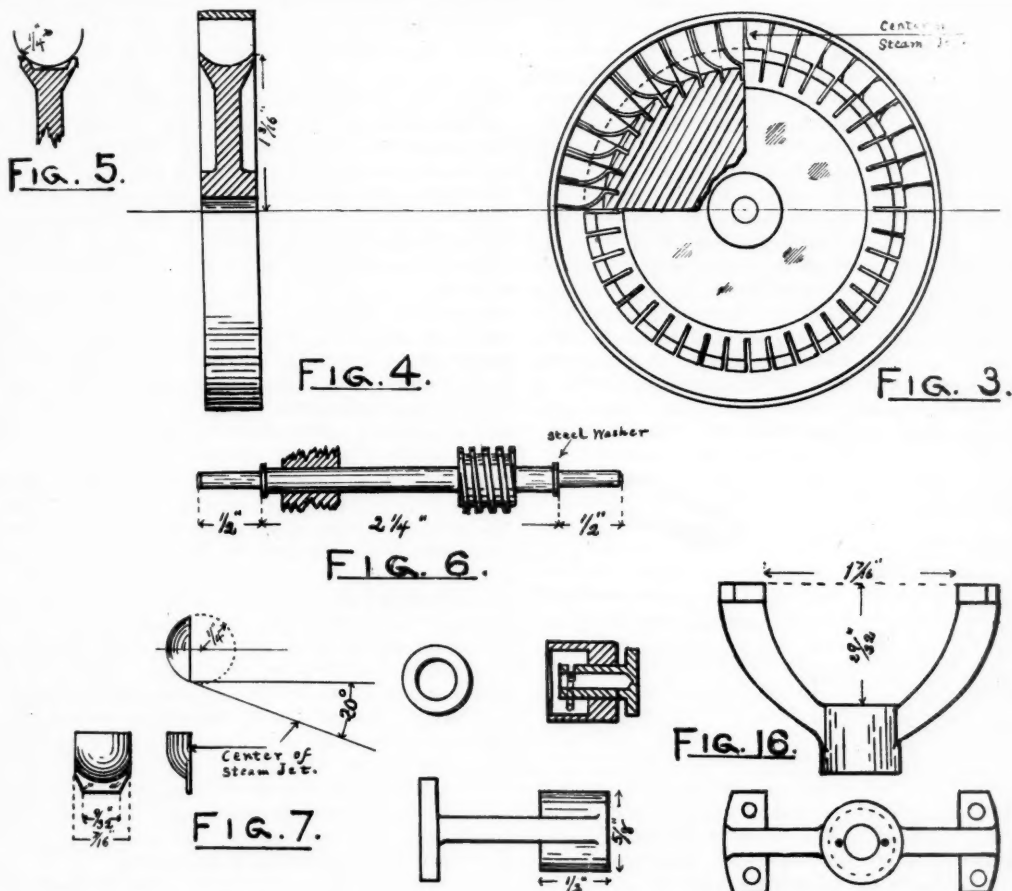
After the required number have been formed up, one of them should be very carefully laid out and cut

to the size and shape shown in Fig. 7, and this can be used as a gauge with which to mark out the others. Fig. 4, the cross section of the turbine wheel, shows the rim turned out to form the same shape as the bottom of the bucket. This can be somewhat modified as shown in Fig. 5, where the bucket rests on two projections, one on either side of the rim and the centre cut away on a straight line. The latter is the easier construction and keeps the buckets in position equally well.

After the wheel is turned to the required shape the slots for the buckets must be made in the rim. If one has a milling machine or a lathe arranged for plain milling, the work is very easy. Most amateurs will be under the necessity of marking off the divisions with dividers and cutting the slots with a hack saw. The divisions should be marked off very carefully and the saw held at right angles to the rim of the wheel when used. After the slots are cut in the wheel and the buckets formed and trimmed they must be soldered in position. Place the wheel flat on a level surface and set the buckets in place. If the slots have been cut with a hack saw the thickness of the metal of the bucket will not fill it up. In that case small pieces of sheet brass can be cut and set in at the front of the bucket. When the buckets are all in place wrap a piece of iron wire around the outer ends to hold them securely while being soldered. In soldering, a flame can be used direct on the wheel, or it can be done with a tinsmith's copper. Do not use a large quantity of solder. All that is required is to lock the buckets while their tops are being turned off to nearly the diameter of the inside of the flat brass ring which is to surround them.

Before the buckets are turned off, the wheel should be placed in a permanent position on the shaft. The ends of the shaft should not be turned down to the size of the bearings, however, until the wheel and buckets are entirely finished. The flat ring surrounding the buckets is made from a piece of three inch brass tubing about 1-16" in thickness. This should be placed on a block of wood which is held in the jaws of the lathe chuck, or fastened to the face plate, and trued up to a width of 7-16" inch.

In turning down the tops of the buckets use a sharp pointed tool and take very light cuts. Turn them down until the flat ring can be almost forced on, then lay the wheel down on a flat surface, heat the ring evenly all around and it will expand sufficiently to drop over the tops of the buckets. It this is carefully done no soldering of buckets to the ring will be necessary. The shaft and wheel are again mounted in the lathe and the wheel carefully turned all over, using a very pointed tool and taking very light cuts. This should put the wheel in perfect balance. Lastly, turn the ends of the shaft to the dimensions shown in Fig. 6. When the shaft and wheel are complete and supported lightly between centres, they should stand in any position in which they are placed. Should the wheel revolve it would indicate that one side of the



wheel is heavier than the opposite side. In this case, it will be necessary to balance it by adding a little to the lighter side or drilling a few small holes in the rim of the heavier side.

The casing of the turbine consists of a piece of $3\frac{1}{2}$ " brass tubing about 1-16" thick shown in Fig. 8. Into each end of this tubing a head is fitted. The tubing should be forced on a wood mandrel turned to tightly fit its inside diameter. Both ends should be trued up parallel, leaving the length of the tubing 11-16". To the lower side of this tube is attached a base, Fig. 9. The upper part of this base is turned out, or carefully filed, to fit the outer curve of the tubing. A boss is cast on one end of the base, and is drilled out to fit the exhaust pipe. Where the drill comes through, an elongated hole will be formed on the top curve of the base. A corresponding hole should be marked out and cut through the side of the tubing, and after the four holes in the feet are drilled the two pieces are soldered together.

The two heads for the casing cannot be made from the same pattern without a considerable waste of

material and extra work. For the head on the "steam" side of the turbine, Fig. 10, the pattern should be made with a straight hub for a chuck piece, as indicated by the dotted lines. This is for the purpose of holding the casting firmly in the chuck while it is turned to fit the tubing; the inside surface turned off; the oil reservoir finished; and the $\frac{1}{4}$ " hole for the bearing bored through. All these operations must be done at one setting; i. e. the castings must not be disturbed in the chuck until all these operations are finished. This is absolutely necessary in order that the parts shall all "line up" when the work is completed.

The $\frac{1}{4}$ " hole for the bearing should not be made by starting a $\frac{1}{4}$ " drill and cutting the hole while the work revolves, for the hole would, in all probability, run crooked. Start with a smaller drill, say 3-16", and when that has been put through, use a small boring tool in the slide rest of the lathe and true up the hole, taking repeated cuts until it is almost to the required size, then run a $\frac{1}{4}$ " reamer through to finish it. The outside diameter of the head should be left a

trifle larger than the $3\frac{1}{2}$ " as it will add to the appearance of the finished model.

When cutting out the oil reservoirs turn out the groove for the brass washer shown in Fig. 11. This washer is to be soldered in place, but this must not be done until the oil ring for the bearing, Fig. 12, has been placed in the aperture and the screw holes of the heads drilled as will be explained later. After finishing the inside of the head it can be reversed in the chuck and held by the inside surface of the flange while the extra part of the chuck piece, shown in dotted lines, is cut away and the end squared up. Two holes are to be drilled into the oil reservoir, one above for the purpose of supplying oil, and the one below to be used to drain the reservoir. They should be drilled with a No. 42 twist drill and tapped with a No. 4-36 tap. Machine screws can be used to stop these holes when the model is in operation.

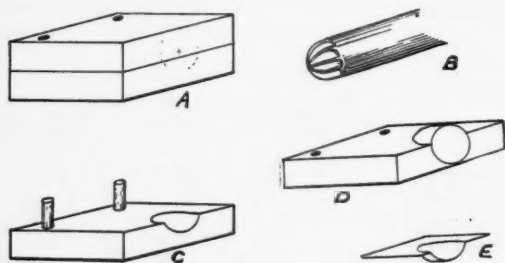


FIG. 10.

The bearing sleeve is clearly shown in Fig. 12, and a cross section of same is seen in Fig. 10. For this purpose a piece of brass rod can be used. Two pieces are to be made, one for each bearing. In addition to the length required for the bearing, the pieces should be cut out of sufficient length to hold in the chuck. When the extra length is gripped in the chuck jaws, centre the end of the revolving piece with a sharp pointed tool and start a smaller drill than the size of hole required; after which the hole is trued up with a very small boring tool held in the slide rest and finished with a reamer. Next turn down the outside to $\frac{1}{2}$ " and square up the shoulder of the outer end. The bearing is held in place by the two small adjusting screws as shown in Figs. 10 and 12. The groove for the oil ring can be cut with a file or hack saw, and the reamer must be again inserted to remove the burr. The oil ring can be made from a piece of tubing.

The next important operation on this head is to drill and ream the steam nozzle in the lug cast on the outer surface. The line of the centre of this nozzle should be at an angle of 20° with the inner surface of the head, as shown in Figs. 13 and 14. Fig. 13 is a horizontal section cut through the centre of the lug. This shows the manner in which the hole is drilled. The position of the hole is laid out on the inside of the head as shown in Fig. 10. It should be on a direct

vertical line with, and $1\frac{5}{16}$ " above the centre of the head. Mark the point with a centre punch. When this has been done a small piece of metal, shown in Fig. 14, should be soldered on just outside. This is to prevent the drill from running off to one side when it is started. A center punch mark should be made on the outer end of the lug at the proper point to bring the finished hole at the proper angle with the turbine wheel. Against this centre punch mark, the point of the back centre of the lathe is placed and the hole drilled. When drilling the hole the head must be carefully held up or its weight will break the drill. Use a No. 60 twist drill. The hole is next reamed out carefully with a taper reamer from the inside of the head. The hole should be $1\frac{1}{16}$ " in diameter at that portion where it emerges into the casing. The outer end can be counterbored from the outside to fit the steam pipe, and the entrance to the nozzle from the pipe beveled off as shown.

The other head requires less work. All the turning can be done at one setting of the casting in the chuck. The projection of the stuffing box on the inside of the head is to be used as a chuck piece. This is firmly grasped in the jaws of the chuck. The outer diameter of the head is first turned down to the same size as the opposite head. The inside flange is next turned down to the same diameter as the inside of the $3\frac{1}{2}$ " tubing. This can be done by using a bent tool in the tool post of the slide rest. It can be gauged for size by using a pair of calipers and setting them to fit the finishing diameter of the flange of the other head. The gauging of the piece of work by the caliper must be done while it stands at rest, for if done when the work is revolving the tendency will be to leave the flange too large, as the calipers pass over a revolving piece of work with greater ease than if stationary.

The outside surface of the head is next turned off true and the recess for the gland bored out to the proper size. The small hole for the shaft should next be put through and this should be done very carefully, as this will aid materially in the final lining up of the parts when the model is assembled, as will be described later. The hole should be first drilled with a smaller drill than the finished size called for, after which a small boring tool is used to true up the hole and fit it to the exact diameter of the shaft of the turbine wheel. The reason for doing this is that when the outboard bearing of the shaft is completed and ready for attaching to the casing, the wheel and shaft can be inserted, and this hole in the stuffing box will hold the shaft in alignment until the bearing can be set into place and the position of the holes for the screws marked on the head. When the outboard bearing has been fitted, the hole in the stuffing box should be enlarged a little so that the shaft will not touch it.

The packing gland is shown in Fig. 17 and will not require an extended explanation. It should be a sliding fit in the stuffing box and the hole should be at least $1\frac{1}{32}$ " larger than the diameter of the shaft. Two clearance holes for No. 2-56 screws should be drilled in

the flange and tapping holes to correspond marked off and drilled in the head. No finishing is required on the inside of this head.

The two heads can now be marked off and drilled for the screws which are to hold the casing together. Lay off six points around the edge of the flange of the head first described, Fig. 10, and mark them with a center punch. Drill these holes through, using a No. 42 twist drill. When all six holes are drilled place the flanges of the two heads together and hold them in position with a clamp. The projection of the stuffing box on one head will enter the oil reservoirs turned in the other head. With the heads securely held together use one of the holes as a guide for the drill and start a hole in the other head. This must not go deeper than the bevel of the lip of the drill. Mark the other five holes in the head in the same manner, after which the two heads can be separated. The holes marked should be drilled through with a No. 33 twist drill, this being a clearance hole for a No. 4 screw. The holes drilled with the No. 42 drill are next tapped with a No. 4-36 tap.

After these holes are drilled the washer shown in Fig. 11 can be soldered in to place to form the oil reservoir in the head Fig. 10. The casings can then be assembled with the wheel and shaft in place.

The outboard bearing should be held in the jaws of the chuck by the outer end of the hub so that the feet project toward the slide rest. Rotate the lathe head by hand and measure with a tool in the rest to see that the piece is chucked so that the feet project equally. With a centering tool in the slide rest mark a center in the revolving hub of the casting, and using the same size drill as used for the hole in Fig. 10 put a hole entirely through to size it for one of the bearings shown in Fig. 12. The details of the parts are shown in Fig. 16.

The oil reservoir is next bored out and the little depression made for the washer. The washer, like the corresponding one in the other bearing, must not be soldered into place until the oil ring has been placed inside. The bottom of the feet must be faced off while the casting is in the chuck, lights cuts with a pointed tool being made so not to loosen work. The piece can then be removed from the chuck and the bearing sleeve fitted. The holes for two adjusting screws are next drilled and tapped, after which the clearance holes for the screws are placed in the feet. The bearing can now be slipped onto the end of the shaft projecting from the assembled casing and the position of the screw holes transferred to the casing.

The head, Fig. 15, must now be removed and the holes drilled and tapped. The hole in the back of the stuffing box can be enlarged, as mentioned, and the head replaced. The worm wheel should next be placed on the shaft in the position shown in Fig. 6 and secured by a very small set screw drilled and tapped into one end of the worm.

The bearing for the driving shaft, Fig. 18, is best finished by centering at both ends and drilling the

the hole when the casting is held against the back center of the lathe. The drill used should be a trifle smaller than 1-4". Be careful that the drill does not touch the end of the back center. When the hole is nearly through, a piece of hard wood or metal should be interposed to prevent injury to the drill or center. The hole can then be reamed with a 1-4" reamer, after which it can be placed on a 1-4" mandrel and the ends squared up. If desired, the outside of the bearing can be turned down and finished on either end. If finish is desired over that portion where the flange is attached it will be necessary to do this with a file as it cannot be turned. The back of the flange should be filed up flat and parallel to the hole for the shaft, after which two screw holes are drilled.

The gear wheel and shaft are fastened together by a pin or screw and placed in position in the bearing. These parts are then held in place on the casing until the position of the screw holes are located. The points of the teeth of the gear should not be allowed to "bottom" on the worm, yet they should have sufficient contact.

If desired, a small sheet metal oil pan can be formed to fit under the gear wheel for lubrication and a cover could be made to enclose all the gearing, but there are so many who prefer to "see the wheels go 'round" that these parts have not been shown. No driving wheel is shown on the end of the driving shaft. This must be made of the proper size to give the required speed to whatever model or piece of apparatus it is required to drive.

When the final adjustment of the parts is made the turbine wheel should run just as close as possible to the head containing the nozzle, but without touching it. Perhaps the easier way to make this adjustment is to loosen the screws in the bearing sleeve of the "Steam" side and screw up the adjusting screws in the outboard bearing until the turbine wheel rubs against the side of the casing when the shaft is revolved by hand. Then turn these screws back a half revolution and carefully tighten up the screws on the "steam" side until the bearing sleeve comes against the shoulder of the shaft. Be careful that the sleeves are not forced up too tight, as it is preferable to have a little play endwise on the shaft though this should not exceed 1-32". A stop cock should be placed on the steam pipe as near the model as convenient.

The uses of seaweed are numerous; it furnishes thousands of tons of fertiliser, many nutritious foods, and a variety of chemicals, especially iodine and bromide. Other uses are in sizing fabrics, as a mordant in dyeing, in refining beer, in making paper, fishing lines, ropes, as an upholstery stuffing, as a packing for china, etc. The Japanese have discovered many uses for this material, of which there are countless varieties.

The Amateur lathe is well worth having.

AN 80-WATT DYNAMO.

W. C. HOUGHTON.

The machine to be described in this article is intended to be of the simplest possible construction consistent with good workmanship and fair efficiency. It is of the bipolar type with a single field coil, and laminated armature. It might be easier to build it with a solid cast iron armature, but its output would be much smaller, while the power required to run it would be greater. Dynamos of such small size are at best rather inefficient because the field magnet must be made very strong or they will not generate.

This machine may be used either as a generator or as a motor. If used for the latter purpose, it will run a small lathe, several sewing machines or any similar machinery. The winding described will be what is known as *shunt* winding, i. e., the field will be connected in multiple with the armature. The effect of this is to make the machine run at practically constant speed as a motor, or to give a constant voltage as a dynamo. Series wound generators are used only for arc lights or for special purposes. They will not charge storage batteries nor run incandescent lights or motors satisfactorily. Series motors are only used where the speed must be varied between wide limits.

First, a few general remarks about methods of construction, and the order in which the various parts of the work should be taken up. All machine work should be completed first. Then the insulation of field and armature should be done, and lastly the winding. To do the machine work a good lathe is a necessity. An engine lathe is best, but a hand lathe with a good slide rest will do, if it will swing at least 9". A planer or shaper and a milling machine can also be used if available, but are not absolutely necessary. The field magnet casting should be taken up first. Plane or file off the feet on the base till it will stand perfectly true and firm. Drill a $\frac{1}{4}$ " hole in each foot, placing it well out toward the end so that screws may be put in easily. Next mark and centre punch the bosses on each side exactly in line with the centre of the cylindrical portion of the field, that is, the magnet core. Centre drill one of the bosses and drill a hole $\frac{1}{4}$ " deep in the other and tap a $\frac{1}{8}$ " No. 16 thread. These are for use in winding the field, which is done in the lathe.

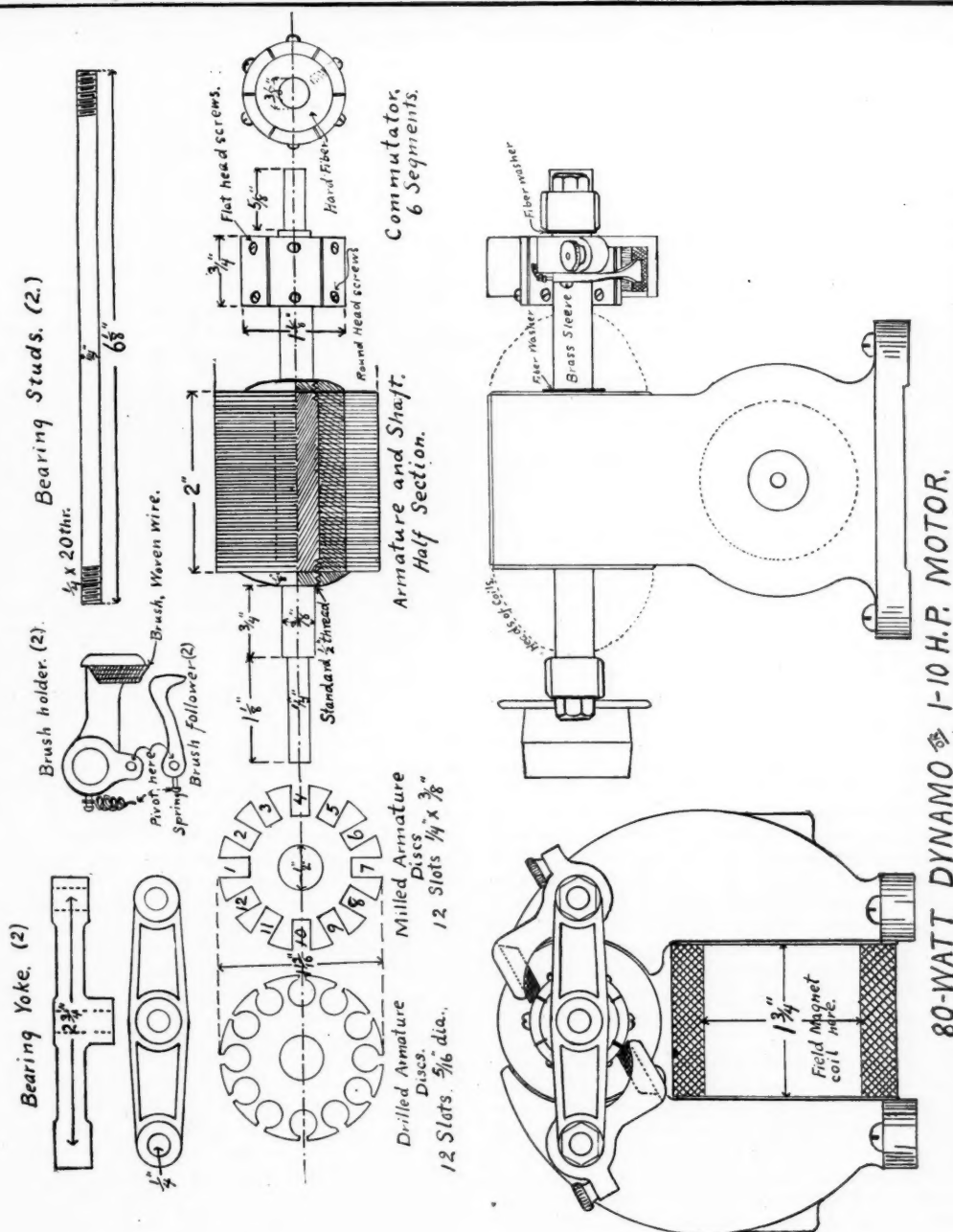
The field may now be bored. This is best done by bolting to tool carriage of lathe, and using a boring bar with fly cutter. The ends of pole pieces may be faced off at the same operation by setting the cutter out and grinding it so it will cut on sides. If the tool carriage is not so built that the casting can be mounted on it, the next best way is to mount it on an angle-plate, which is then bolted to the large face plate of lathe. The work is then done with an ordinary bor-

ing tool. The boring need not be particularly smooth, but must be true, and of the same size from end to end, namely $1\frac{1}{2}$ ". Ends should be faced off to 2" length of bore. The next thing is to drill two $\frac{1}{4}$ " holes through the pole pieces parallel with the armature shaft and $1\frac{1}{2}$ " from the centre of it. To insure getting these right, the best way is to make a jig, which will also be used in drilling the bearing yokes which must be spaced exactly the same. Take a piece of iron and turn it to fit the bore of the field magnet, and drill a $\frac{1}{4}$ " hole through the centre of it. Next take a piece of flat bar steel say $\frac{1}{4}$ " x $\frac{1}{4}$ " and $3\frac{1}{2}$ " long, scribe a centre line on flat side and drill three holes as per drawing of yokes. Drill two more holes between for rivets.

Put a piece of $\frac{1}{4}$ " steel through centre hole and through hole of round piece. Spot through and drill the two small holes, and rivet or screw the two together. The jig is then ready for use. Put the disc in field magnet bore, turn so that the centre line is parallel with the base, clamp in place and drill the holes through pole pieces. These are for the side rods that support the bearings. If a suitable counterbore is available, both ends of these holes should be counterbored out, but this is not really necessary. This completes the work on the field magnet.

The bearing yokes should be filed fairly true on the back side of the end bosses, and then put in a 4-jaw chuck, two jaws holding on to the ends and the other two gripping the sides back of the central boss. The outer bosses may now be faced off, and the centre boss turned to $\frac{1}{4}$ " diameter, faced off and drilled and reamed to $\frac{1}{4}$ " for the bearing. The yoke is then turned over in chuck and the back of all three bosses faced off. Then take out of chuck, put on the jig with pin through centre holes and drill the side rod holes $\frac{1}{4}$ " diameter. Small oil holes may now be drilled and if desired, tapped for oil cups and the bearings are finished. The side rods are merely two 6" pieces of cold rolled steel $\frac{1}{4}$ " in diameter, threaded with a die, $\frac{1}{4}$ " on each end; thread $\frac{1}{4}$ " No. 20. The brass sleeves which serve as distance pieces will be described later.

The armature will now be taken up. First get some of the softest sheet iron, smooth and free of scale. Have a tinsmith cut from this enough 2" squares to make a pile 2" high when pressed together. Stack these up, hold them even with clamps, (wooden hand screws will do) and drill a $\frac{1}{4}$ " hole through the middle of them. Then clip off the corners with hand shears making them roughly octagonal. Now get two pieces of $\frac{1}{4}$ " soft steel, 2" square, drill and tap holes in the centre with standard $\frac{1}{4}$ " thread. The shaft is made of a 7" piece of 9-16" or $\frac{1}{8}$ " machinery steel which should



be centered, turned down to $\frac{3}{8}$ " for 2" on each end and the middle $\frac{1}{4}$ " diameter. Thread the $\frac{3}{8}$ " portion for about $\frac{1}{2}$ " at each end with a die (standard) and screw on one of the $\frac{1}{4}$ " pieces of steel. Hold shaft upright in a vise and string on the armature discs, first shellacing them or else putting thin shellaced paper

between them. Put on the other $\frac{1}{4}$ " end piece, and screw up very tight, using a wrench and holding by the lower disc, not by the shaft.

The corners of the $\frac{1}{4}$ " pieces may now be cut off with a saw, and the whole put in lathe and turned off to 1 13-16" diameter. This job of drilling and turning

the discs may be avoided if punched discs can be obtained, but that is usually difficult. Now comes the slotting of the armature. Two ways of doing this will be given. The best way is to mill them, if a milling machine is available, or this can be done in a machine shop at an expense of 50 to 75 cents. There should be 12, $\frac{1}{4}$ " slots, $\frac{1}{8}$ " deep. If this cannot be done, a fair job may be done by laying out 12 holes on the end discs 3-16" from the outside, equally spaced, and taking care to get marks on the two ends exactly opposite. Holes 19-64" diameter may then be drilled from each end till they meet. The holes are then reamed to 5-16". Slots $\frac{1}{4}$ " wide may next be cut in each hole with a hack saw and smoothed with a file. The armature is then replaced in the lathe, and the end plates turned down to the bottom of the slots, and rounded off. The shaft is then finished to dimensions as per drawings. This completes the machine work on the armature.

The commutator is next in order. Take a piece of hard red fibre, or hard maple, which has been dried by baking in a slow oven, and drill a $\frac{1}{8}$ " hole through the centre. If fibre is used, this hole should be at right angles to the layers to avoid danger of splitting. Drive on an arbor and turn down to $\frac{1}{4}$ " diameter and face off both ends to $\frac{1}{4}$ " length. Cut a piece of brass tube $\frac{1}{8}$ " internal diameter, and $\frac{1}{4}$ " thick to $\frac{1}{4}$ " length, drive on the fibre and turn off ends flush. With a pair of dividers lay off the circumference into 12 equal parts and mark these lengthwise of the commutator. On each alternate line lay off screw holes 3-32" from the end. Drill and tap screw holes, being careful to make the holes radial. Drill clearance holes through the brass and tap the fibre with 4-36 tap. Take care not to drill quite through to centre hole of commutator or you may get a short-circuit. Countersink holes in one end of commutator for flat head screws. Put in all screws and saw through brass on the six lines between screws, sawing into the fibre about 1-32". Take off one segment and put a strip of hard fibre or mica covered with shellac in the saw cuts on each side and screw down again. Repeat with alternate segments. Let shellac harden, put commutator in lathe on an arbor and turn off smooth, except the end where round head screws are.

The brush holders do not need very much description. They are finished by filing up, drilling and tapping for binding posts, and pivot screws for pressure fingers, as per drawings. The brushes are made of short pieces of a regular woven wire brush, cut off obliquely on the ends as shown. The brush holders are soldered directly to the sleeves on the bearing rods. These sleeves are made of brass tube, 5-16" inside diameter, and about 1-16" thick. Pieces of $\frac{1}{4}$ " brass pipe, iron pipe size, are just the thing. If this is used the brush holders are drilled with a 13-32" drill which will just fit. The sleeves must be insulated from the frame by winding shellaced paper around the rods and putting mica or hard fibre washers under each end. This does not allow the brushes to be adjusted

by swinging around the commutator, but this is not necessary, as the commutator can be slightly turned on the shaft at first and no adjustment will be needed.

The machine is now ready to be insulated and wound. Cut a strip of heavy paper 12" long, and 1 $\frac{1}{4}$ " wide, cover it with thick shellac, and wrap it tightly around the field magnet core. Cut four washers from thick paper, or two from thin hard fibre, slit in one place and put on ends with shellac. Put field in a lathe by screwing one end on a cap screw or threaded piece of steel, held in a chuck and support the other on the back centre. Wind with 13 layers of No. 21 single cotton covered magnet wire. A layer of hard white cotton cord such as is used for chalk lines is put on for protection, and the whole given two coats of shellac.

The armature winding may now be taken up. First thoroughly insulate the slots, heads and parts of the shaft $\frac{1}{4}$ " out from heads with shellaced paper. Put armature between lathe centres for convenience. Number the slots from 1 to 12. Start winding at the commutator end of slot No. 1 crossing back head and bring back through slot 8, keeping the wire always on the same side of shaft. Wind in this way 5 layers of 4 turns each, taking great care to make the wire lie flat and straight in slots and as smoothly as possible on the heads. When finished, twist the two ends of coil together temporarily, at the point of starting. Double cotton covered wire No. 18, American gauge, should be used. When first coil is complete, turn armature half around and wind a similar coil, beginning in slot 7 and coming back in slot 2. Each coil occupies two slots. When first two coils are complete, test for "grounds" with an electric bell and batteries, or a magneto if available. In like manner, wind coils in slots 3-10 beginning in 3, 9-4, beginning in 4, 5 12, and 11-6, beginning at 5 and 11. Test for grounds after winding each pair of coils. When winding is done, soak all coils thoroughly with shellac and bake in a slow oven, taking care to leave oven door open to avoid burning. When cool the coils may be connected up ready to attach to commutator. Take the *outside* end of coil in slot 1, scrape off cotton and twist with *inside* end of coil in slot 8. Outside end of coil in 3 is connected to inside of coil in 5. In like manner go around armature. There will then be six terminals which are to be fastened under the six round head screws on commutator. After testing machine so as to be sure everything is right, these connections may be soldered. The machine may now be assembled and tested. Connect one end of the field coil to each brush holder. Connect the machine with three or four cells of battery. It must be run as a generator in the same direction it runs as a motor. If it sparks, turn the commutator slightly one way or the other on the shaft.

The field magnet may be finished in black enamel if desired, and any other finishing touches the builder may fancy can be added. The winding here given will give 10 volts at 3000 R. P. M. and a current of 8

amperes may be safely used, or more for a short time. No pulley for driving has been described. This should be about 1 $\frac{1}{4}$ " diameter and $\frac{3}{8}$ " face for a $\frac{1}{4}$ " flat belt. It should have a flange on side toward the machine to keep belt from catching should it slip and run off.

The cost of materials for this machine is about \$2.50 if the builder can make his own patterns. If castings are bought, of course the cost is a little higher. A machine of this capacity and of equal efficiency is worth at least \$10.00 when complete.

HOW TO BUILD A SAIL-BOAT.

CARL H. CLARK.

V. Fitting Centreboard and Finishing Cabin.

The foundation may now be removed from under the boat, and she may be supported upon blocks and shored upright. At this time it will be well to put in place the remaining bolts in the mast step. The stem also should be planed down to follow the surface of the plank, leaving the face only about $\frac{1}{4}$ " wide, which face is fitted with a half round galvanized iron band, extending well down on the keel. The top of the stem is cut off about $\frac{1}{4}$ " above the deck and trimmed down to a tenon about $\frac{1}{4}$ " wide. The keel under the after overhang is also to be trimmed down to the surface of the plank and smoothed off to follow the same angle.

The skeg is of 2" oak fitted to the curve of the underside of the keel. The after end is plumb and is rounded out to admit the rudder post after being thinned down to 1 $\frac{1}{4}$ " thick. The forward end extends to the end of the centerboard slot and is rounded up as shown in Fig. 13. At the forward end a rivet may be driven, but elsewhere it must be fastened from above by lag screws driven through the keel. This skeg must be nicely fitted and be well fastened so there will be no tendency to work sidewise. The rudder stock is 1 $\frac{1}{4}$ " diameter of galvanized iron of the proper length to reach from the bottom of the skeg to about 3" above the standing room seat. There are four or five $\frac{1}{4}$ " holes drilled through it to take the fastenings for the wood blade, and at right angles to these a $\frac{1}{4}$ " hole is drilled at the top to take the tiller bolt. A tube is provided which is a turning fit for the stock and has a threaded end. A block is fastened on the top of the keel, as shown in Fig. 13, and a hole is bored of proper size to allow the tube to be screwed in, which should be done after smearing the threads with lead. In order to be sure that the tube is screwed in perfectly plumb, the rudder stock should be inserted, and the lower end held firmly while the tube is being screwed into place with a pipe wrench.

After the centerboard box is built the floor of the cabin and standing room can be laid. The floor beams are about 2" x $\frac{3}{4}$ " spruce; forward and aft of the centerboard box they run across and rest upon the frames, the ends being beveled off. In the way of the centerboard box the beams must, of course, be cut and strips, as shown in Fig. 13, are fastened on to the box

with screws to take the inner ends of these beams. The flooring of both cabin and standing room is of $\frac{3}{4}$ " pine laid in straight boards. The middle boards are left loose to give access to the space below. Around the outside, next to the side of the boat, it is fitted to shape. A strip should be laid also on the on the slant of the frame and fitted to the curve, to prevent articles from sliding down under the flooring.

The sidelights in the cabin trunk are about 12" long and 4" wide, and of elliptical shape. They are cut out with a compass saw, a small hole being bored to allow the cut to be started. The inner edge is rounded and on the outer side a rabbet about $\frac{1}{4}$ " wide and $\frac{1}{4}$ " deep, is cut around. Into this rabbet the glass is set and the corner filled with putty. A pair of screw ventilators about 3" in diameter, set into the trunk on the forward end, will be found to give good ventilation and are not expensive.

There should be a transom or berth fitted on each side and across the forward end of the cabin, about 6" high, and 2' wide, at the after end, tapering towards the bow. A board is left loose in the top, giving locker space below. It may be desirable to cover the frames on the inside of the cabin with thin sheathing, if it is intended to use the boat for cruising, as this will protect somewhat against the dampness and moisture. A door should be fitted to the forward bulkhead, opening above the transom, and fitted with hinges and latch.

The opening in the cabin roof is now to be trimmed out to the third beam, making an opening about 2' long and 2' wide. The after bulkhead is finished out to make the opening the same width; the lower edge of the opening being a few inches above the standing room floor. The edges of the bulkhead around this opening are lined with a casing about 3 $\frac{1}{4}$ " wide, with a ledge all around, against which the cabin doors will close; this is shown in Fig. 13, and would be best made with a rabbet on the outside to fit over the edge of the sheathing.

The slides and hatch on the top of the cabin are made as shown. The slide pieces are 4 $\frac{1}{4}$ " high at the after end tapering to 2" at the forward end and are about 4' long. They are provided with a groove on

their inside faces $\frac{1}{2}$ " \times $\frac{1}{2}$ " about $\frac{1}{2}$ " down from and parallel with the upper edge. The outer corner is rounded off. The cross pieces of the slide are provided with a projection which fits the groove in the side pieces and allows them to slide.

The boards of the top of the slide are $\frac{1}{4}$ " matched and laid fore and aft. The beams are cut on a camber considerably greater than that of the cabin roof as shown in Fig. 15. The middle beam should be quite thin in order to pass over the top of the casing at the forward end of the opening. The aftermost cross piece should be in such a position that when the slide is closed it will be just even with the ledge on the casing so that the doors will close against it when they are shut. The opening in the roof inside the hatch is cased up with $\frac{1}{2}$ " stock along the sides and across the front, as in Fig. 13; at the after end the casing should make a good joint with the vertical door jambs, and across the forward should extend high enough to overlap the forward cross pieces of the slide and keep out spray and wash. When this work is neatly done it adds much to the appearance of the boat. The cabin doors would best be bought, as they are rather difficult to make and does not cost much if bought at the proper place. They must be rounded at the top to fit under the slide, and must be cut out to fit around the centreboard when the latter is drawn up.

An oak top is to be made for the centreboard casing with a neatly rounded edge and a slot at the after end to allow the board to pass through. A folding table leaf about 2' 6" long and 12" wide may also be hinged to this top piece, folding down against the box when not in use. The cabin can be fitted with such additional lockers, and shelves as the fancy of the builder may indicate. The standing room seats are built about 15" above the floor, and about 12" wide outside of the coaming. They rest upon cross braces, the outer ends of which are supported by turned posts. The seat across the after end is arranged to give support to the rudder tube by a block or by other means. If desired, the space underneath the side seats may be enclosed by sheathing and fitted with removable doors, forming good locker space, in which case the bulkhead across the after end need extend only down to the level of the seat. If the seats are open underneath, a removable door is fitted to the after bulkhead.

The rudder is $1\frac{1}{2}$ " thick at the stock and tapers towards the after end. The several pieces run parallel with the stock, and are bored with $\frac{1}{2}$ " holes to match those in the stock. Galvanized iron rods are then driven through and the whole set up tightly; washers are put on the outer ends of the rods, and both ends of the latter riveted, drawing the whole tightly together. A slot is cut to allow a strap 3-16" \times $1\frac{1}{2}$ " to be passed around the stock; the rudder is put in place, and this strap inserted and fastened to the deadwood with screws. It holds the rudder and deadwood together. A piece of flat galvanized iron is also fastened on the bottom of the keel under the heel of the

stock to support it and prevent grass or ropes catching between. The tiller is of oak and has a plate on each side extending back past the rudder head. Holes are drilled to match the one in the rudder head and a bolt passed through.

The centreboard is built up of narrow boards held together with $\frac{1}{2}$ " galvanized iron rods. The after side must be shaped on a circle, with the pin at the forward end as a centre. The board may be about 2" shorter than the box to give some clearance. The lowest board should be of oak and the others of hard pine. The rods should be about 8" apart. It will hardly be possible to run each one all the way through, but they should be as long as possible, and where one stops the next one should overlap it to preserve the strength. It will add to the strength and appearance of the board if it is shod with $1\frac{1}{2}$ " half round galvanized iron; if this is not done, a piece of lead weighing about 20 lbs. should be set into the lower corner to sink the board. The hole for the pin at the forward end ought to be lined with metal to avoid wear; a rowlock socket set in flush with the surface will answer excellently. The hole in the box sides to take the pins must be bored in about the position shown in Fig. 13. The board is put in from below and the bolt passed through the two sides and the centreboard. Under the head of the bolt and under the washer on the opposite end a piece of rubber packing should be placed to keep out the water. A rope is attached to the after corner of the centreboard to lower it and haul it up. The board should be placed in its highest position and a hole bored just above the top of the centreboard casing, through which a pin may be inserted to hold the board up when not in use.

The planking and deck should now be planed and finished. As little should be taken off as possible. A smoothing plane, set fine, should be used, and the planks should be planed until they are perfectly fair and smooth. The corner at the bilge should be slightly rounded and also the corner of the covering board should have the sharp edge taken off, otherwise it will be apt to chip out. The planking and decks (if bright) should next be calked with cotton. Cotton for this purpose comes in balls already prepared. It is forced into the seams with a "calking iron" a sort of flat chisel shaped tool. The seam is first coated with paint. A thread of the cotton then started in the seam and forced in by hammering the "iron" with a mallet, gradually moving along the seam and working in a small loop of the cotton at short intervals, the size of the loops and their frequency being governed by the size of the seam. It is advised that the amateur, if possible, visit some place where he can see this done, as more can be learned that way than by a large amount of description. Calking is a rather particular piece of work, and care must be used not to force the calking too tightly, as there is some risk of loosening the plank. The edges of the plank may be raised somewhat by calking; if so, a light shaving may be taken off. The whole surface of the plank

may now be thoroughly sandpapered; the seams filled with putty and given a coat of paint. The deck, if canvassed, and also the housetop, is painted at the same time. If the deck is laid in strips it may be puttied and painted if desired, but the neatest way is to fill the seams with marine glue and varnish it. This marine glue is a preparation somewhat like tar, and requires to be melted and run into the seams with a ladle. It is allowed to harden and the surplus scraped or planed off. The whole surface is then given a coat of shellac and two coats of good varnish.

It will be necessary to strike in the waterline, the easiest way of doing which is as follows:—at the required height forward and aft a horizontal straight edge is fastened. The boat being on an even keel, one person sights across the two straight edges and a second places a pencil on the boat in such a position as to be in line with the two edges when sighted by the first. In this way, a series of points are obtained through which a curve is drawn with a batten. It is advised that the waterline be struck about 2" higher than that in the design, as it is advisable to have it

show a little, and it also prevents the side paint fowling as quickly. The outside should have a final coat of paint, and the bottom be covered with some form of anti-fowling or copper paint, the latter being put on after the topside paint.

The remainder of the bright work, cabin trunk, coaming, slide, doors, etc., should now be given a coat of shellac and two coats of varnish. All varnished work should be first coated with shellac, as it fills the grain and makes a better surface. The after bulkhead may be varnished if desired, but it is advised that the standing room floor and seats be painted as it wears better. The hole for the mast is about 5" diameter. Before cutting the mortise in the step the boat should be placed with the waterline level, a plumb-line is dropped from the centre of the mast, thus locating the centre of the mast on the step. The mortise is about 4" long and 1 1/2" wide. For ballast, iron is probably the most available material, although small stones in canvas bags may be used if necessary. It is put in place after the boat is afloat and ready for final trimming, and in the position to bring her to trim.

PRINTING FOR BEGINNERS.

FREDERICK A. DRAPER.

VII. Job and Advertisement Composition.

To select and arrange types in such a way as to produce a well balanced, properly accented and artistic result requires skill which is not attained in a few weeks or months. Only by the careful study of materials and all the better forms of printed matter can the worker reach that degree of efficiency which would entitle him to be termed an "ad architect" as one well known printing house designates its workmen. To point out the way by which one may become competent in these lines is the most that can be attempted in these columns.

The beginner in job composition can adopt no better rule than to collect samples of the work of the leading printing houses in his locality, become a regular reader of at least one magazine devoted to the trade, of which *The American Printer*, published by the Oswald Publishing Co., New York City, and the *Inland Printer*, published by the Inland Printer Co., Chicago, Ill., are the two likely to be of most value to the beginner. In both of these magazines are departments devoted to critical reviews of job and advertising composition, and the merits of specific examples afford the reader the opportunity of learning the requisites of correct work.

An excellent book for the beginner is a "Book of Job Composition," published by the Oswald Publishing Co., New York City, which gives 133 type designs submitted in a prize contest. It is a book of 40 pages

and costs only 50 cents, and is well worth the money to any beginner. A similar book is published by the Inland Printer Co., Chicago, Ill., and is mailed for 40 cents.

The most prolific source of examples of good advertisements is that of the leading popular magazines, the advertising pages of which are worthy of the most careful and continued study. It will be found, however, that the reader will be able to acquire the ability to do skillful work only after becoming thoroughly familiar with each and all the different faces of type with which he has to work; this familiarity meaning the value which each face has in design, strength of color and artistic effect in combination with other faces.

One error quite common to the beginner is the disposition to use too large a size, filling up about all the available space with type matter. As experience is gained, the value of "white paper" or clean spaces will be learned; smaller sizes of type with suitable margins will be found much more effective than the monotonous sameness of crowded matter.

The use of rules, borders and ornaments is to broaden a subject, and too closely related to the peculiarities of the particular work in hand, to allow of specific directions. Here again, the popular and printers magazines will be found the best school in which to study. It will be noted that the present style, with

type, is to keep to as few faces as possible, different sizes being used to secure contrast, as well as extended, condensed and italic of the same series. From this it will be gathered, that, in equipping an office, the selection should favor the different sizes of one series in preference to the same number of fonts divided among different faces. The owner of one newly equipped office, to keep the first cost as low as possible, adopted the expedient of alternating sizes between two series of about equal measure, filling in the balance of the series as the means permitted or demands required. The object in doing this was to give to the printed work the appearance of having been done in a more perfectly equipped office.

The assortment of type in an office which caters to the general trade, even if only on small work, must include two or three series of both extended and condensed faces and a few sizes of an extra condensed series will be found very useful. Two or three "poster fonts" (25 pounds) of Modern or Old Style type for

solid matter will also be needed; in fact, the amount which can be profitably invested in what may be considered as really necessary type and materials, can easily be made to reach the \$1000 mark, and then not have much of an outfit. Included in such a list would be the following series, which will be found in the catalogues of the larger type manufacturers:

DeVenne.	Gothic.
DeVenne, Condensed.	Gothic, Condensed.
DeVenne, Extended.	Gothic, Extra Condensed.
DeVenne, Italic.	Gothic, Italic.
Jensen.	Gothic, Extended.
Jensen, Condensed.	Howland.
Post.	Latin Antique.
Post, Condensed.	Bold Face.

The series may not, in the catalogues of the different manufacturers, be designated by these names, as manufacturers have their own trade names for type faces which are alike. On the other hand the faces, while similar, are not always just the same, which must be kept in mind when ordering.

JUNIOR DEPARTMENT

For the Instruction and Information of Younger Readers.

ELEMENTARY MECHANICS.

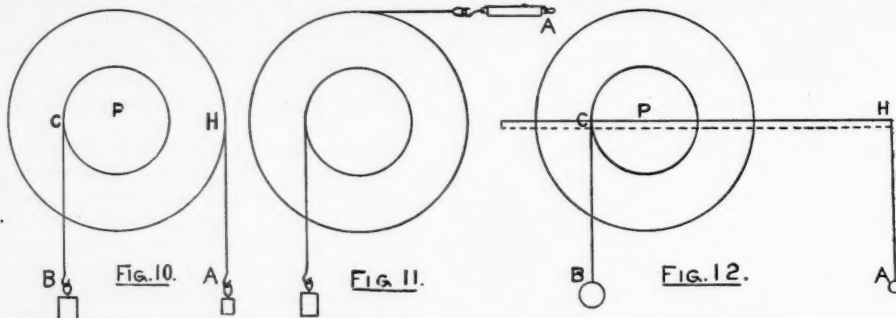
J. A. COOLIDGE.

IV. The Wheel and Axle.

Although there are nominally six simple machines, the lever, the pulley, the wheel and axle, the inclined plane, the wedge, and the screw; and although these machines are generally very different in appearance, they may be divided into two classes, according as the machine turns about a fixed point or pivot when the

Weight arm, may be seen to be true in these machines. The inclined plane, on the other hand, finds its modifications in the wedge, and in the screw which is a movable inclined plane in spiral form.

The wheel and axle is like a lever in this; first, that it turns about a pivot; and second, that the power and weight are attached to it at different distances from the pivot, thus making a long and a short arm. The lever is limited in its actions in that the weight can be lifted only a short distance, while in the wheel and axle, the weight may be lifted a much longer dis-



weight is moved, or the machine is made to slide under the weight, or the weight is made to slide or roll over the surface of the machine. Thus the lever may include the wheel and axle, and the pulley, and the laws of the lever:—Power \times Power arm = Weight \times

tance, in some cases many feet.

For experimenting with the wheel and axle much time and trouble may be saved, if one has an old bicycle wheel and its bearings. The large wheel with the tire removed furnishes an excellent wheel and

the axle, or better a slightly larger axle made from a spool, may be made to furnish an attachment for the weight to be lifted. As comparatively few have such conveniences we will give directions for making a wheel that will serve our purpose. An axle may be made from a rod of brass or smooth iron 6" long, and 5-16" diameter. A wheel 3" diameter should be carefully cut from some $\frac{3}{8}$ " stock, and two pieces $3\frac{1}{2}$ " diameter cut from some $\frac{3}{8}$ " stock should be glued or nailed, one on each side. This will make a grooved wheel. A better one can be made if one has access to a turning lathe, or if one can cut one out of a roller of some kind. A wooden rolling pin costing five cents will furnish wheels for a dozen. A smaller wheel 1" in diameter and with the larger one must be centered and fastened with shellac or cement to the metal axle. The axle should be mounted in a frame or box at least 15" high. Two stout linen threads smooth and flexible should be used. Fasten one to the rim of the wheel and wind it around the wheel four or five times so that it shall unwind left handed, as can be seen at C, Fig. 10. The other should be fastened to the smaller wheel or axle and should be wound in the opposite direction as in A of the same figure.

At A and B fasten two of the weights we have made and used in our former experiments making them balance. If any difficulty is found in doing this, some small additional weight may be added either to A or B. Compare the weight at A with that at B. Compare also the distances RH and PC. Using the hand as an extra force pull down on A and measure the distance B rises while A descends 6". Also notice the speed with which A moves as compared with that of B. As the diameter of the wheels are 3" and 1", the radii, or distances PH and PC are as 3 to 1; the distances moved by A and B should be 6" and 2"; and the speed of A should be three times that of B. If the weight B is not found to be three times the weight A the difference is due to friction.

To determine the friction in the experiment, let us use, instead of a weight at A, the spring balance and pull in a horizontal direction as seen in Fig. 11. The average of the force necessary to raise B and that required to let it descend slowly will be the true force A. Compare this with the weight used before at A. Try several cases of equilibrium between A and B, using forces at A, of 8, 16, 24 oz. as the force and record in tabular form.

A. 8 oz.	B. oz.
16 oz. oz.
24 oz. oz.

Does $A \times PH = B \times PC$? If this is so the law of the lever is again verified, and may be called law of the wheel and axle. The power \times the radius of wheel = the weight \times the radius of axles. The ratio of the force needed, to the weight to be moved may be found by dividing the radius of the wheel by the radius of axle. The brakes on cars and the steering apparatus on board a vessel are about the only illustrations of the wheel and axle one is likely to see;

but many modifications are in use and can be seen far more frequently. The crank and axle is the same machine with this exception that all of the wheel is removed except one or two spokes, and that the force is applied at the end of a spoke. The power in some cases may be applied anywhere along one of the spokes, thus allowing the power arms to be of different lengths. In many machines the crank is curved so that all semblance of a wheel is gone. The derrick, windlass, capstan, brakes on electric cars, and many other contrivances are examples of the wheel and axle.

Take two pieces 12" long, $\frac{1}{2}$ " wide and $\frac{3}{8}$ " thick, and nail them to the wheel just used so as to make two arms as shown in Fig. 13. If we consider the original wheel as the hub of an enlarged wheel, and PH as a spoke of this wheel, we may experiment with this as a crank and axle. The pivot P is the same, the cord at C holds the weight B, and the power A is attached 12" from P. $PH \div PC =$ the ratio of weight to the power. As the power arm PH is so much larger than PC the weight is very much larger than the power.

On the bottom of our box directly under B fasten a screw eye. Make the cord CB shorter and hang on the lower end a spring balance, fastening the hook to the screw eye in the floor beneath. Hang on the end A just weight enough to hold the balance vertical. Place extra weights at A, in each case recording the pull exerted on the spring balance. The balance records for us the weights that can be lifted at B by the forces used at A. Try forces of 2, 4, and 6 oz. at A and again see whether the law holds true.

Some of the values of the crank and axle may be seen from the following examples:—Here are some men moving a house. A horse is attached to the end of a bar that turns an axle set vertically and around which a rope is being coiled as the horse turns the axle. The other end of the rope is fastened to a house set on rollers. If the bar to which the horse is attached is 10' long, and the pull of the horse after allowing for the loss by friction, is 1000 lbs. the value of the power \times the radius of the wheel, i. e., the length of the bar, is $10 \times 1000 = 10,000$. As the weight moved \times the radius of axle must equal this sum, if the radius of axle is $\frac{1}{2}$ a foot, $\frac{1}{2} \times$ the weight moved = 10,000 and the whole of the weight moved = 20,000 pounds. Of course the weight represents the pull exerted on the house, and as the house rests on rollers, this pull must be able to move a weight many times larger. With a loss from friction of 50%, the weight would be doubled, or 40,000 lbs. The force exerted by the horse, in a real case of house moving, is increased several times by a system of pulleys.

The sailors are hoisting an anchor. Each at the end of a capstan bar is pushing with a force of 50 lbs. If the bar is 8' long, the total force of 100 lbs. will make the value of power \times length of crank, $100 \times 8 = 800$. If the radius of the capstan is 6", $\frac{1}{2} \times$ the weight moved = 800, and the whole weight = 1600

lbs. With a larger force from each man, with more men and less friction, much greater weights can be lifted. Sometimes the power exerted on the crank is not applied directly to the weight, but the circumference of the axle is a toothed wheel and fits or "meshes" into the circumference of a larger wheel. The second wheel moves more slowly than the first and may be attached in the same manner to a third. These gear wheels allow an immense gain in power although there is considerable loss from friction and the weight is moved very slowly. In transferring power from one set of shafting to another, the friction of the belt on the circumference of the wheels transfers the motion from one to the other. By making one wheel large and the second small a very great speed may be obtained. For example, suppose the large wheel have a diameter of five times the smaller, then the speed of the smaller will be five times the larger. By adjusting these differences any speed desired may be obtained.

HOW BOYS CAN EARN MONEY. II.

CUTLERY AND TOOL SHARPENING.

Any boy who can secure the use of a grindstone or emery wheel can engage in this business, which, if industriously followed up, will be found quite profitable. In most any place a sufficient number of families can be visited, orders obtained for sharpening kitchen knives, scissors, hatches and axes; also if sufficiently skillful, planes, chisels and other tools. Some practise may first be necessary with such of these articles as may be found at home, as future orders will depend upon satisfactory work with those received the first time. A good whetstone will have to be used to complete the work done upon the grindstone or emery wheel. Care must be used on cutlery to grind evenly and not too thin on the cutting edge.

With scissors a slight bevel is given, and the edge must be very even and smooth. Examine a new pair to get the correct shape. The charges should be moderate, five cents for knives and ten cents for scissors.

ELECTRICITY BY EXPERIMENT.

III. INDUCTION.

The magnets used to perform the previous experiments were made of steel, and incidentally it may be stated that the harder the steel, the longer will the magnet retain its strength, and also the greater the current required to first magnetize it. Soft iron, on the other hand, while becoming quickly magnetized, also quickly parts with magnetism when the exciting cause is removed.

EXPERIMENT 8.

Obtain a short piece of soft iron; the core from the magnet of an old electric bell if one is to be had, or at some blacksmith or machine shop a piece of $\frac{1}{4}$ " Nor-

way iron. Place the piece of iron on a piece of smooth writing paper and sift the iron filings over and around it. Observe that there is no attraction of the filings to the iron. Hold one end of the bar magnets near the piece of iron, but not touching it or the filings. It will now be seen that the piece of iron attracts the filings; that the magnet has *induced* magnetism in the piece of iron. By holding one of the suspended needle magnets near the piece of iron, but on the opposite end from the bar magnet, it will be observed that the iron has two poles. Test for polarity with the suspended magnet, changing the poles of the bar magnet.

Place between the bar magnet and the piece of iron a strip of thin glass. Observe that the magnetism is still retained in the piece of iron. Other non-magnetic substances such as wood, rubber, brass, etc., may likewise be placed in the same place as the glass, and yet not interfere with the magnetic induction of the piece of iron, showing that magnetism will act through all known substances with the single exception of iron. Place a strip of iron cut from a tin (tinned iron) in place of the glass and note that the piece of iron is no longer magnetized. The strip of tinned iron acts as a *screen* to divert the lines of magnetic force.

The piece of iron, under the influence of the bar magnet, becomes quickly magnetized. This property is known as the *permeability* of the iron. Should the piece of iron have been only moderately soft, it would not entirely part with the magnetism after removing the magnet; that remaining being known as *residual magnetism*, a property of value in dynamos which will be more fully considered in subsequent chapters. The steel magnet, which holds its magnetism has what is known as *retentivity*. These various properties should be thoroughly studied, as they have an important bearing on the functions of many pieces of electrical apparatus and machines.

The Morse Twist Drill & Machine Co., New Bedford, Mass., have issued a new catalogue of 250 pages, in which their well known tools, together with many new ones are presented with a most excellent typographical appearance. This catalogue should be on file in every manual training school and machine shop in this country, and will be mailed upon request. In this connection a suggestion is made that those sending for it include 10 cents to cover postage, thus showing a disposition to meet manufacturers, in part, in what is a heavy expense for circulating information of decided value to all users of tools.

Catalogue No. 18A, wood working machinery, and 18 B, "Star" lathes, issued by the Seneca Falls Mfg. Co., Seneca Falls, N. Y., give detailed information relative to the well known and excellent machines manufactured by this company. The "Star" lathes have made for themselves an enviable reputation, being well designed, well made and finely finished. The other machines made by this company are equally efficient and favorably known where used.